Ref. 9

APPLICATIONS FOR MINING PERMIT

in response to

SOUTH CAROLINA MINING COUNCIL
CHAPTER 89, ARTICLE 1, MINING ACT REGULATIONS
SECTION 48-19-50 of the SOUTH CAROLINA CODE of LAWS

for

OPERATION OF MINE ACTIVITIES

BARITE HILL GOLD MINE
McCormick County
McCormick, South Carolina

April 6, 1989

Prepared for:

Gwalia (U.S.A.) LTD
1675 Broadway, Suite 2350
Denver, Colorado 8020

Prepared by:

Environmental Technology Engineering, Inc.
P.O. Box 1867
Lexington, South Carolina 29072

Reviewed by:

D.P. Engineering, Inc.
7125 West Jefferson Ave., Suite 300
Lakewood, Colorado 80235

TABLE OF CONTENTS

MINING PERMIT APPLICATION

SOUTH CAROLINA LAND RESOURCES CONSERVATION COMMISSION
DIVISION OF MINING AND RECLAMATION
2221 Devine Street, Suite 222
Columbia, S. C. 29205

APPLICATION FOR A MINING PERMIT

"The South Carolina Mining Act," Sections 48-19-10 through 48-19-230, Code of Laws of South Carolina, 1976, as amended provides in part: "After January 1, 1975, no operator shall engage in mining without having first obtained from the Department an operating permit which covers the affected land which has not terminated, been revoked, been suspended for the period in question, or otherwise become invalid." (Section 48-19-40)

MINE

1. Name of Mine Barite Hill County McCormick

2. Name of Company Gwalia (USA) LTD.

   (Check form of business entity: Corporation ☒ Partnership ☐ Limited Partnership ☐ Sole Proprietorship ☐

3. Home Office Address 1675 South Broadway, Suite 2350 (Street Address or P. O. Box) Denver (city) Colorado (state) 80202 (zip code)

4. Permanent Address for Receipt of Official Mail same as above (name)

   (Street or P. O. Box) (city) (state) (zip code) Telephone

5. Mine Office Address (city) (state) (zip code) Telephone

6. Location of Mine Between U.S. 378 and U.S. 221, off Road 30 State ~~or~~ or County Highway South of McCormick Nearest Town or City

7. Mine Manager Michael Drozd, Gwalia (USA) LTD.

8. Locate accurately on a county map, or draw a detailed sketch map of: (1) how to get to your local office and (2) how to get to the mine and attach to this application.

Permit #______

9. If land is leased, complete the following:

a. Name of lessor Not Applicable

Lessor's address ______
(Street Address or P.O. Box) (city) (state) (zip code)

Lessor's telephone ______

b. Date of lease ______

A. GENERAL CHARACTERISTICS OF MINE:

1. Total acreage for which permit is requested. Acres owned 326 Acres leased 0

2. Materials mined: GOLD

3. Mining method: Hydraulic Dredge ☐ Self-loading scraper ☐ Underground ☐ Shovel & Truck ☒

Dragline & Truck ☐ Other ______

4. Will blasting be a part of your operation? Yes ☒ No ☐

5. Present depth of mine 0 feet

6. Expected maximum depth of mine(s) Elevations: 350 feet MSL

B. DETERMINATION OF AFFECTED ACREAGE AND BOND:

1. Number of years for which permit is requested Five (5) (10 years maximum)

2. Total affected acreage:

a. Area used for tailings ponds or sediment control ponds 0 acres

b. Area used for stockpiles of unprocessed minerals 5 acres

c. Area used for spoil banks and disposal of refuse (exclusive of tailings ponds) 110.9 acres

d. Areas used for on-site processing facilities, stockpiles of processed minerals and access 9.4 acres

e. Area for excavation during the period of this permit 15.3 acres

or

If mining and reclamation are to be done by segments, estimate acres of segments: ____________ acres x 3 = Not Applicable acres
(Show these segments on Question 13 of reclamation plan and map)

TOTAL OF 2a THROUGH 2e 140.6 acres

3. Check acreage to be bonded: total affected acreage figure from B-2 equals acreage to be bonded.

☐ 0 - 4.99 acres (bond - $2,500) ☐ 5 - 9.99 acres (bond - $5,000)

☐ 10 - 24.99 acres (bond - $12,500) ☒ 25+ acres (bond - $25,000 or more)

4. Will this operation be covered by a blanket bond? Yes ☐ No ☒

If so, check the amount of blanket bond:

☐ $2,500 ☐ $5,000 ☐ $12,500 ☐ $25,000 or more

C. PROTECTION OF NATURAL RESOURCES:

1. Describe the wildlife or freshwater, estuarine or marine fisheries in the area of the mining operation.

   Please see attached "Environmental Survey Report,"

2. Is there a waste water treatment system at your plant or mine? Yes ☐ No ☒

3. Is there a point source discharge from your plant or mine? Yes ☒ No ☐

4. Is there an air contaminant emission from your mine or plant? Yes ☒ No ☐
   Fugitive Dust Emissions

5. Do you anticipate pumping of groundwater? Yes ☐ No ☒

6. Describe methods to be used to prevent physical hazard to persons and to any neighboring dwelling, house, school, church, hospital, commercial or industrial building, or public road.
   The mine location is remote. There are no potential physical hazards to persons or neighboring dwellings for they are beyond a one-half mile radius from mine activities.

7. Describe methods to be used to prevent an adverse effect on the purposes of a publicly owned park, forest, or recreation area. The mine location is remote. No adverse effect is anticipated on any publicly owned park, forest, or recreation area. Present U.S. Forest Service lands, adjacent to proposed mine lands, shall become the property of applicant before mining activities commence. Nearby Lake Thurmond is a recreational lake and shall be protected from any mine pollutants from applicant's compliance with a NPDES permit.

8. Describe measures to be taken to insure against (1) substantial deposits of sediment in stream beds or lakes, (2) landslides, (3) acid water pollution on adjacent property.
   Please see attached "Description of Mine Activities Report," Section 5.0: Hydrologic Design

9. Describe measures to be taken for screening the operation from public view.

   The mine location is remote. No screening measures are planned.

10. Attach one (1) copy of a map that contains the following: Please see attached "Description of Mine Facilities Report"

a. Outline of the area that will be affected during the number of years for which the permit is requested; Section 2, Figure 2.1

b. Present ownership of land immediately adjacent to the area to be affected as shown on county tax maps, surveys, or other reliable sources; Please see attached "Property Holdings at Barite Hill", Figure 2

c. Outline of planned pits or excavations; Drawing 190-1

d. Outline of areas for the storage of naturally occurring soil that will be suitable for the establishment of vegetation in the final reclamation; Drawing 190-1

e. Outline of planned areas for disposal of refuse, exclusive of tailings ponds; None

f. Outline of planned spoil banks; Drawing 190-1

g. Outline of areas to be occupied by peaks or ridges; Drawing 190-1

h. Locations of planned access and haul roads on the area to be permitted; Drawing 190-1

i. Outline of planned tailings and sediment control ponds; Drawing 190-1

j. Location and name of streams and lakes and existing drainage ditches within the area to be affected with arrows indicating the direction which the water flows in such streams or ditches; Drawing 190-1

k. Outline of areas on which temporary or permanent vegetation will be established to control erosion during the mining permit; None

l. Outline of areas for stockpiles of unprocessed minerals; Drawing 190-1

m. Outline of area of previously mined land that will not be affected; None

n. Outline of the area to be occupied by processing facilities including stockpiles or processed minerals, if such facilities are to be an integral, on-site part of the mining operation; Drawing 190-1

o. A legend showing the name of applicant, the name of the proposed mine, the north arrow, the county, the scale, the date of preparation, and name and title of the person who prepared the map. Drawing 190-1

The required map shall have a neat, legible appearance and be of sufficient scale to show clearly the required information. The base for the map shall be either a specially prepared line drawing, aerial photograph, enlarged USGS topographic map, or a recently prepared plat, or a quality copy of any of these.

Permit # ________________

We hereby certify that all information and details contained hereinabove and on the map are true and correct to the best of our knowledge. We fully understand that any willful misrepresentation of facts will be cause for permit revocation.

11. The operator acknowledges that Section 48-19-100, Code of Laws of South Carolina, 1976, provides in part:

> "Upon receipt of the operator's annual report or report of completion of reclamation and at any other reasonable time the Department may elect, the Department shall cause the permit area to be inspected to determine whether the operator has complied with the reclamation plan, the requirements of this chapter, any rules and regulations promulgated hereunder, and the terms and conditions of this permit. Accredited representatives of the Department shall have the right at all reasonable times to enter the land subject to the permit for the purpose of making such inspection and investigation.

Michael D[illegible]
Signature of Operator or His Authorized Representative

Vice President - Operations
Title

4/5/89
Date

D. SUPPLEMENTAL INFORMATION REQUIRED BY THE DEPARTMENT; PURSUANT TO REGULATION 89-3 (for Department's use only):

E. ADDITIONAL TERMS AND CONDITIONS OF THE PERMIT REQUIRED BY THE DEPARTMENT (for Department's use only):

Permit #______

TO BE COMPLETED BY DEPARTMENT

The foregoing application, together with the map dated ________, ________, and the reclamation plan dated ________ ________ are hereby approved. A permit for mining operation, conditioned upon mining and reclamation performed as set forth in the application and plan and in accordance with the foregoing additional terms and conditions will be issued upon the posting of a reclamation bond in the amount of $__________. No mining shall take place until a permit for the mining operation has been issued.

LAND RESOURCES CONSERVATION COMMISSION

By: ______________________________
Division Director

Date: ______________________________

NOTICE: You must file an application to modify the permit and reclamation plan in the event the actual operation varies from that set forth in the above-referenced application and reclamation plan.

FOR OFFICE USE ONLY:

Permit No. ______________________

Date Issued ______________________

Expiration Date ______________________

Renewal Date ______________________

Cancellation Date ______________________

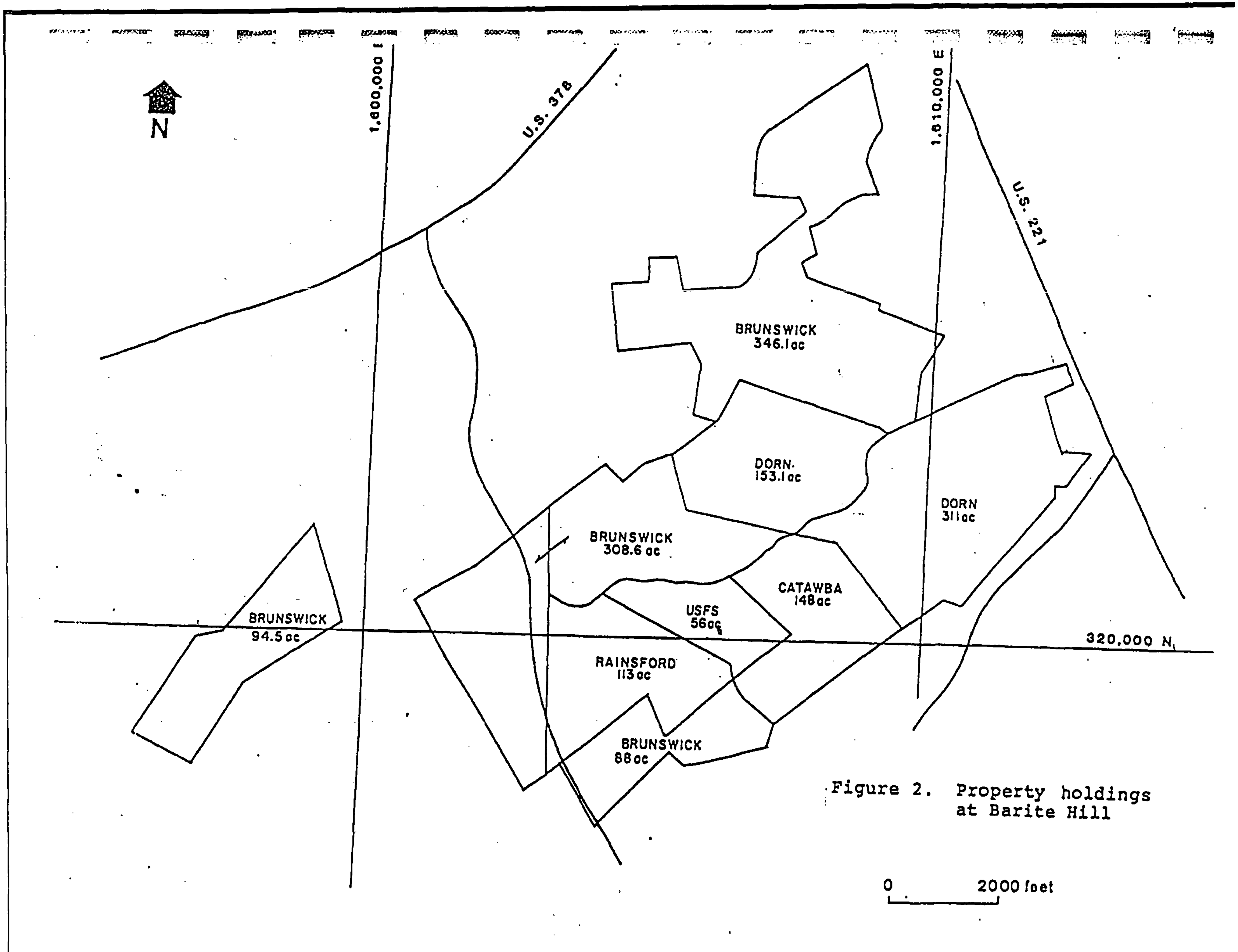


Figure 2. Property holdings at Barite Hill

RECLAMATION PLAN

SOUTH CAROLINA LAND RESOURCES CONSERVATION COMMISSION

DIVISION OF MINING & RECLAMATION

2221 Devine Street, Suite 222

Columbia, S. C. 29205

RECLAMATION PLAN

Permit Number ____________
(to be assigned by the Department)

1. Name of Mine Barite Hill Project

   County McCormick

2. Name of Company Gwalia Resources (International) LTD

3. Home Office Address 1675 South Broadway, Suite 2350, Denver (city)

   Colorado (state) 80202 (zip code)

4. Permanent Address for Receipt of Official Mail ____________ (name)

   1675 South Broadway, Suite 2350, (Street Address or P. O. Box) Denver, (city) Colorado (state) 80202 (zip code)

   Telephone (303) 592-4580

5. Mine Office Address 1675 South Broadway, Suite 2350, Denver, (city) Colorado (state)

   80202 (zip code) Telephone (303) 592-4580

   Location of Mine Between Hwy's U.S. 378 and U.S. 221, off Road 30, (state or county highway) McCormick, S.C. (nearest town or city)

6. Mine Manager Michael Drozd, Gwalia (USA) L.T.D.

RECLAMATION PLAN

Permit #__________

1. What useful purpose(s) will the affected land be reclaimed to (check one or more)?

a. lake or pond	______	f. grassland	__x__
b. agriculture	______	g. recreation	______
c. woodlands	______	h. marsh land	______
d. residential	______	i. park	______
e. commercial	______	j. other	______________

2. Describe practices to protect adjacent resources such as streams, roads, wildlife areas, woodland, cropland and others during mining and reclamation. Please see the following sections in the attached "Description of Mine Activities Report",
   a. Section 5.4, Sediment Control Structures;
   b. Section 6.4, Pad Leak Detection System;
   c. Section 6.6, Solution Ponds;
   d. Section 7.0, Mine Waste Disposal Areas;
   e. Section 8.0, Operation and Monitoring; and
   f. Section 9.0, Reclamation.

3. Surface Gradient Restoration

(a) What will be the final maximum surface gradient in soil, sand, or other unconsolidated materials on the reclaimed lands? (slopes steeper than 3H:1V must have prior approval by the Department)

3H: 1V

(b) Proposed method for accomplishing surface gradient:

Please see the following section in the attached "Description of Mine Activities Repo

a. Section 9.1, Surface Grading and Restoration

4. Describe the plan for revegetation or other surface treatment of affected area(s).

Please see the following section in the attached "Description of Mine Activities Report",

a. Section 9.4, Revegetation

Permit #__________

5. Method of prevention or elimination of conditions that will be hazardous to animal or fish life in or adjacent to the area (include safety, pollution, sediment and/or other measures). The mine location is remote. No adverse effect is anticipated on animal and fish life or on any publicly or privately owned lands. Additionally, present U.S. Forest Service lands, adjacent to proposed mine lands, shall become the property of applicant before mining activities commence. Nearby Lake Thurmond is a recreational lake and shall be protected from any mine pollutants from applicant's compliance with a NPDES permit

6. Method of rehabilitation of settling pon

Please see the following section in the attached "Description of Mine Activities Report,"
   a. Section 9.0, Reclamation

7. Method of control of contaminants and disposal of mine refuse. Please see the following sections in the attached "Description of Mine Activities Report",

   a. Section 6.0, Heap Leach Facility Design;
   b. Section 7.0, Mine Waste Disposal Areas; and
   c. Section 8.0, Operation and Monitoring

8. Method of restoration or establishment of stream channels and stream banks to a condition minimizing erosion, siltation and other pollution.

Not Applicable; deterioration of stream channels or banks is not anticipated.

9. Method of controlling erosion and off-site siltation from temporary spoil banks and ridges. Please see the following sections in the attached "Description of Mine Activities Report",
   a. Section 5.4, Sediment Control Structures;
   b. Section 7.0, Mine Waste Disposal Areas;
   c. Section 8.0, Operation and Monitoring; and
   d. Section 9.0, Reclamation.

0. What are your plans for maintenance to insure that the reclamation practices established on the affected land will not deteriorate before released by the Department? Regular inspections of the reclamation practices established and monitoring of their performance shall be conducted. In the event that practices are deteriorated before they are released by the Department, the applicant shall ensure prompt repair or re-establishment of such practices, within a reasonable period of time.

1. Outline provisions of reclamation for safety to persons and to adjoining property in all excavation of rock. (Include such provisions as setbacks, fencing, signs, benches, boulders, etc.)
The mine location is remote. There are no potential physical hazards to persons or neighboring dwellings for they are beyond a one-half mile radius from mine activities. Appropriate setbacks, fences, signs, and roadways shall be established to protect on-site personnel.

. What provisions will be taken to prevent noxious, odious, or foul pools of water from collecting and remaining on the mined area?

During all mining activities, the applicant shall ensure that collected pools of water within the mine areas shall be disposed of promptly and properly to avoid stagnation.

FORM MR-500
2/12/80

Permit #______

13. Enter below your time schedule of reclamation activities that meets the requirements of Section 48-19-70 of the South Carolina Mining Act.

RECORD OF OPERATOR'S PLAN AND PROGRESS

Reclamation Practice	Segment # or Area	Planned **		*Applied		Notes
		Amount	Year	Amount	Month and Year	
Total Reclamation	A	20.2	9/91			
Total Reclamation	B	49.1	9/93			
Total Reclamation	C	41.6	9/93			
Total Reclamation	Leach Pad & Ponds	9.4	9/93			
Total Reclamation	Pit Areas	15.3	9/93			
**Event dates are based upon a facility start-up date of 9/89						

*To be completed by the Department.

YOU ARE HEREBY NOTIFIED THAT:

1) you must file an application to modify the reclamation plan in the event actual reclamation varies from that set forth hereinabove, and

YOU ARE FURTHER NOTIFIED THAT:

2) Section 48-19-100 of the South Carolina Mining Act provides as follows:

"If at any time the Department finds that reclamation of the permit area is not proceeding in accordance with the reclamation plan and that the operator has failed within thirty days after notice to commence corrective action, or if the Department finds that reclamation has not been properly completed in conformance with the reclamation plan within two years, or longer if authorized by the Department, after termination of mining on any segment of the permit area, it shall initiate forfeiture proceedings against the bond or other security filed by the operator under Section 48-19-130. In addition, such failure shall constitute grounds for suspension or revocation of the operator's permit, as provided in Section 48-19-120."

Signature of Operator or Authorized Representative [signature]

Date 4/5/89 Title Vice President-Operations

FOR OFFICE USE ONLY

Permit No.____

Plan Approved____________________________________

By Date

Permit Issued____________________________________

Date

Plan Modified____________________________________

Date

PRE-BLAST SURVEY

PRE-BLAST SURVEY

I. Introduction

This submittal is a description of the existing conditions and a summary of the requirements regarding proposed surface and pit blasting activities at the Barite Hill Gold Mine Facility, located in McCormick County South Carolina, as part of the mine operator's submittal of a mining permit application for this facility, and as required by the South Carolina Mining Council, Chapter 89, Article 1, Mining Act Regulations, Section 48-19-50 of the South Carolina Code of Laws. Surface and pit blasting are proposed at this facility for it has been determined that this is the most efficient method of excavating rock and mineral deposits for subsequent removal from the pits and ore processing.

II. Description of Mine and Blast Areas

The total acreage owned by the mine operator is 326 acres. The area affected by mine operations consists of approximately 140.6 acres; two (2) pit areas, where the ore is mined, occupies 15.3 acres; three (3) areas, totaling 110.9 acres, are designated for depositing and grading of tailings;

5 acres are designated for stockpile areas; and the ore processing facility occupies 9.4 acres. The remaining 185.4 acres of unaffected lands surround the entire mine operation areas.

The two (2) areas at the facility where blasting is proposed are in the mine pit areas, designated as the Rainsford Pit area and the Main Pit area. The nearest private dwelling or building not associated with the blasting activities in these pits is beyond a one-half (1/2) mile radial perimeter of each pit area; therefore, pursuant to regulations, it is not necessary to perform a structural investigation of any potentially affected public or private dwellings. Additionally, it has been estimated that the effect on humans and livestock outside this perimeter shall be minimal. The nearest public roads are unimproved secondary state roads and are also located beyond the perimeter boundary.

Medium to dense vegetation cover the facility lands with the exception of some harvesting of various timber. Major vegetation communities present are pine, upland hardwoods, and bottomland hardwoods. This vegetation limits the facility and pit areas from public view and it is estimated that this vegetation may help control noise and atmospheric shock waves as a result from blasting events.

III. Blasting Requirements

Pursuant to the South Carolina Mining Council, Chapter 89, Article 1, <u>Mining Act Regulations</u>, Section 48-19-50 of the South Carolina Code of Laws, the following is an excerpt:

<u>89-11 Surface Blasting Requirements.</u>

A. The operator shall keep accurate records of the use of explosives including, but not limited to, spacing, depth, and pattern of holes, pounds of explosive per delay, total pounds of explosive used per event, and the date and time of the blasts. These records shall be retained for at least three years.

B. When the Department finds it necessary to monitor a blast in an investigation of a written complaint, the operator upon written request from the Department shall give the Department forty-eight hours notice before blasting, such request to become effective forty-eight hours after receipt of the written request.

C. Access into the blasting area shall be regulated by the operator to protect the public and livestock from physical effects of flyrock.

D. In all blasting operations the maximum peak particle velocity measured in any three mutually perpendicular directions shall not exceed one inch per second at the immediate location of any dwelling, public building, school, church, or commercial or institutional building. The maximum peak particle velocity requirement does not apply to structures within the permitted area, or any area that is owned or leased by the operator. Leased as used above shall include structures on which the operator has acquired waiver to damage rights.

E. An equation for determining the maximum weight of explosives that can be detonated within any 8-millisecond period is contained in the following paragraph. If the blasting is conducted in accordance with this equation, the maximum peak particle velocity shall be deemed to be within the 1-inch per second limit.

The maximum weight of explosives to be detonated within any 8-millisecond period may be determined by the formula W = (D/60) where W = the maximum weight of the explosive, in pounds, and D = the distance, in feet, from the blast to the nearest dwelling, school, church, or commercial or institutional building.

IV. Blasting Operations

The mine operator shall regard the above regulations as minimum requirements for blasting operations and shall outline the proposed blasting criteria to be used at this facility in the pursuit of appropriate blasting permits. Blasting permit applications shall be submitted to the appropriate Fire Marshall's agency and no blasting activities shall commence until such permit is granted.

Surface and pit blasting, excavation of rock and ore, and grading activities shall ultimately shape the mine pits. The pit areas shall be mined to a depth of approximately 350 feet above Mean Sea Level (MSL), removing approximately 3.9 million tons of ore and rock. Final pit slopes shall be 1H:1V with 12 foot wide benches.

<u>ENVIRONMENTAL SURVEY</u>

(Report to be submitted upon completion)

RECLAMATION BOND

(Proof of Bonding shall be provided upon Agreement to Reclamation Plan and Cost Estimate)

DESCRIPTION OF MINE FACILITIES ENGINEERING REPORT
BARITE HILL PROJECT

DESCRIPTION OF MINE FACILITIES FOR THE BARITE HILL PROJECT

McCORMICK COUNTY, SOUTH CAROLINA

PREPARED FOR

GWALIA (USA) LTD.
DENVER, COLORADO

PREPARED BY

WATER, WASTE AND LAND, INC.
FORT COLLINS, COLORADO

REVIEWED BY

D.P. ENGINEERING, INC.
LAKEWOOD, COLORADO

MARCH, 1989

DESCRIPTION OF MINE FACILITIES

FOR THE BARITE HILL PROJECT

Prepared for:

Gwalia (USA) Ltd.
1675 South Broadway, Suite 2350
Denver, Colorado 80202

Prepared by:

Water, Waste & Land, Inc.
2629 Redwing Road, Suite 200
Fort Collins, Colorado 80526

Reviewed by:

D.P. Engineering, Inc.
7125 West Jefferson Avenue, Suite 300
Lakewood, Colorado 80235

March, 1989

The design of The heap leach facilities and ancillary features described in this report for Gwalia (USA) Ltd's Barite Hill Project have been prepared by Water, Waste and Land, Inc. and D.P. Engineering, Inc. under the direct supervision of Mr. Don Poulter P.E., South Carolina Registration No. 11490.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 GENERAL

Gwalia (USA) Ltd. (Gwalia) is proposing to construct and operate the Barite Hill gold mining project in McCormick County, South Carolina. The project will consist of two small open pit mines, mine waste disposal areas and a heap leach facility consisting of an asphalt-lined reusable pad, solution ponds and a process plant to recover gold from the leach solutions. The project is approximately three miles south of the community of McCormick, accessible by U.S. Highway 221. Figure 1.1 shows the location of the project.

The leach pad, ponds and process facilities are designed as a closed-loop circuit (or closed system), and will have a net water consumption requirement. Therefore, no treatment facilities for solution discharge are incorporated in the process facility design. Sediment control from the mine waste disposal areas will be provided by retention basins within the disposal areas.

1.2 TERMS OF REFERENCE

The engineering and design for the Barite Hill Project heap leach facility (excluding the process plant and associated pumping systems) has been completed for Gwalia by Water, Waste & Land, Inc. (WWL) in conjunction with D.P. Engineering, Inc. under contract to Gwalia. The design has been based on the following information:

a. Data generated in evaluation of the Barite Hill property by BP Minerals Corporation.

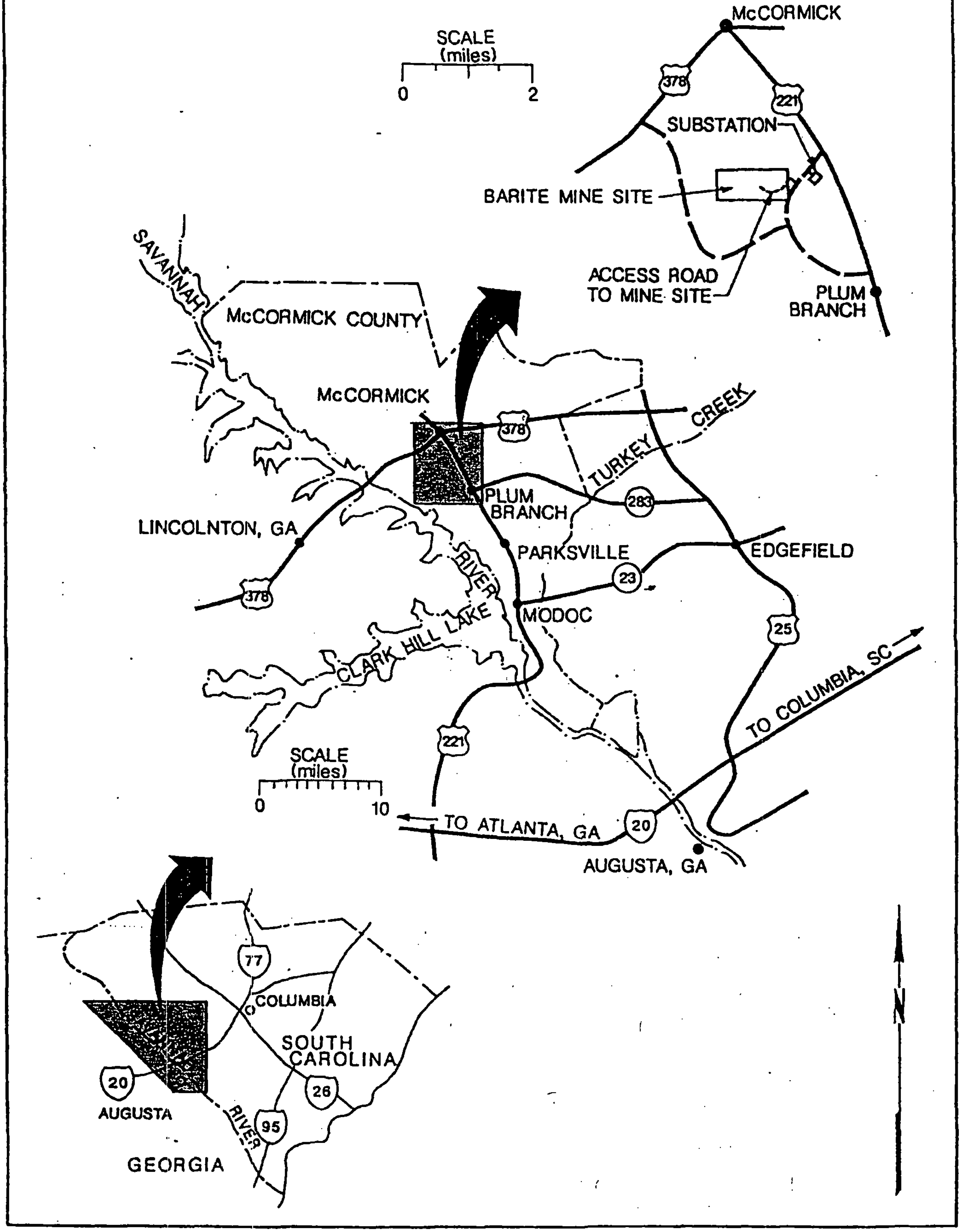
b. Design concepts and operational data developed by Gwalia and Scotia, Inc. (of Salt Lake City, Utah).

c. Site exploration and testing conducted by or under the direction of WWL.

1.3 SCOPE OF REPORT

This report describes the design of the leach facilities and associated mine features, with emphasis on control and limiting of process solutions and protection of surface and groundwater resources.

The main report contains the description of these facilities, how they are to be constructed and operated, and the key elements in their design.



Water, Waste & Land, Inc.	FIGURE 1.1 PROJECT SITE LOCATION	Date: MAR 1989 Project: 190

Supporting field and laboratory test data and calculations are presented in appendices to this report. Also included as an appendix to the report are the earthwork and synthetic liner specifications and drawings for construction.

1.4 DESIGN CRITERIA

The leach pad, ponds, and associated facilities have been designed according to the following criteria.

a. Operation of leach facilities as a closed-loop circuit (or closed system), where leach solutions are kept within the facilities, and runoff from outside the area unaffected by mining and leaching is kept separate from processing facilities.

b. Process solutions will be contained without discharge. Sizing of ponds was made for normal leach operation and heap draindown, plus runoff from the 100-yr, 24-hr storm, plus maximum collection of solution during wet climate conditions, plus 2 ft of pond freeboard.

c. Sizing of diversion channels and solution conveyance channels for peak runoff from the 100-yr event.

d. Minimum acceptable factors of safety for slope stability of 1.5 under static conditions and 1.1 under seismic conditions.

2.0 SITE DESCRIPTION

2.1 GENERAL

The project site is located about three miles south of McCormick, South Carolina will impact about 326 acres of land (shown on Figure 2.1). It is located along a topographic high area in the headwaters of an unnamed tributary which drains into Hawe Creek. Clark Hill Reservoir (recently renamed Sloan Lake) on the Savannah River is about 3 miles to the west of the project.

2.2 TOPOGRAPHY

The project site lies along a ridge above tributaries to Hawe Creek (Figure 2.1). The average elevation along the ridge is about 480 ft, with elevation of about 510 ft being the ridge high point, and elevations along the Hawe Creek tributary on the northern boundary of the site at about 400 ft. The surrounding topography is comprised of rolling hills with the ridgelines at about elevation 500 ft.

The site topography and elevations shown in this report and on the attached drawings are based on USGS topography maps. No additional aerial photography or site surveying has been used for this design.

2.3 VEGETATION AND WILDLIFE

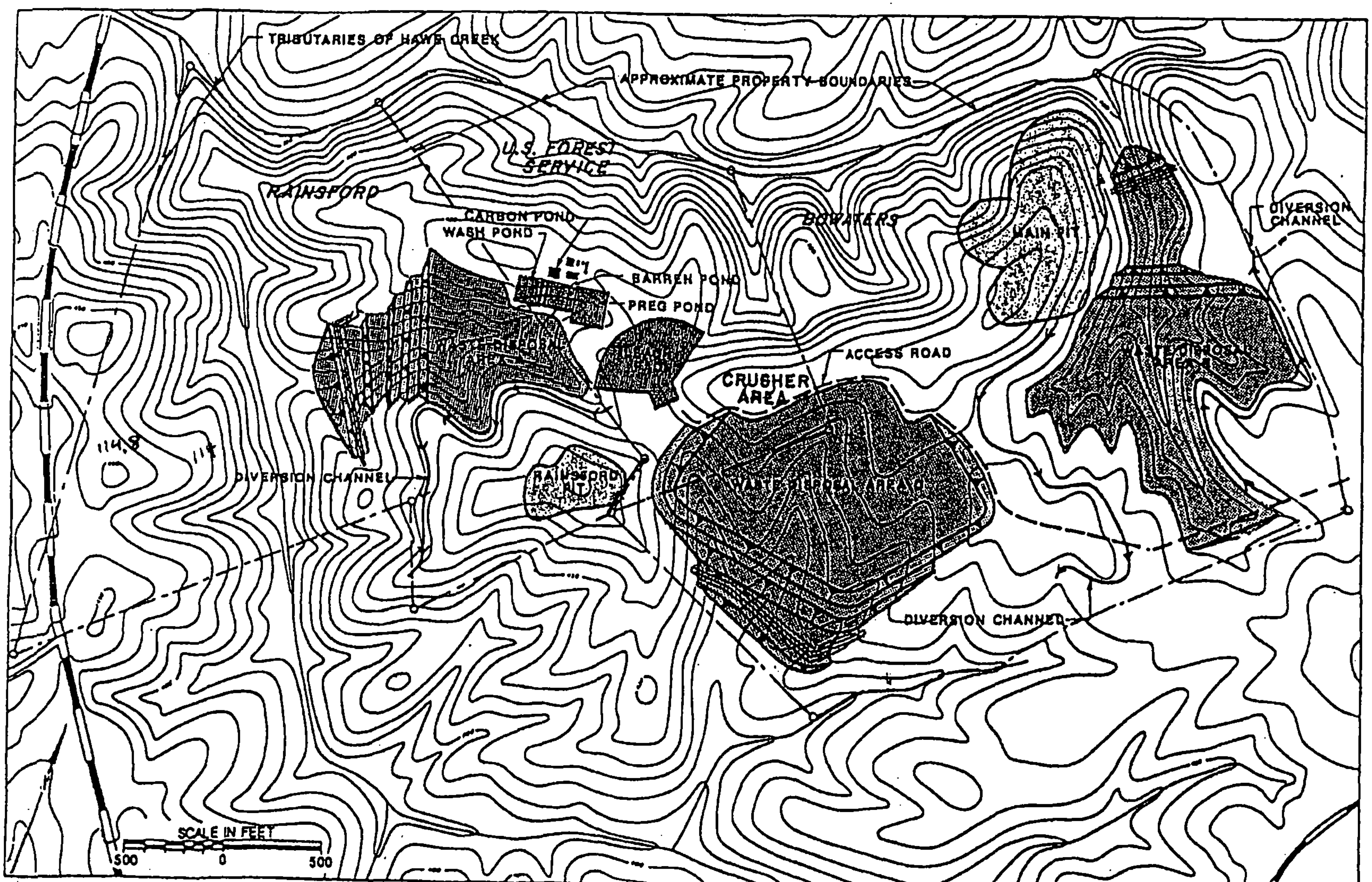
The site is generally a wooded area with a mixture of second growth pines and hardwoods. About 52 acres along the mid to western end of the ridgeline were recently clear cut for lumber production.

The site is not within the boundaries of any areas designated as "Wildlife Management Areas" by the State Wildlife and Marine Resource Agency.

A wildlife and vegetation study for the site is being completed as a separate report.

2.4 CLIMATE

The project is located in a region of moderately high precipitation. Based on data collected from regional weather stations, the annual precipitation and evaporation are 47 and 46 inches respectively. A more detailed description



1" = 770'

9240

53.1

Water, Waste & Land, Inc

Date: MAR 1989

Project: 190

FIGURE 2.1
MINE AREA MAP

160.7

161.3

329

of the site hydrology related to the design is presented in Section 5 of this report.

2.5 LAND STATUS

The project planned for development consists of approximately 274 acres of fee land and 52 acres of land controlled by the U.S. Forest Service (USFS). A land trade has been negotiated with the USFS for acquisition and control of the USFS property. The design has been conducted assuming that no federal lands will be impacted.

2.6 SURFACE HYDROLOGY

The most significant surface drainages at the project site are two tributaries to Hawe Creek (Figure 2.1). One perennial tributary runs along the north side of the site and by visual observation contains the highest flow. The second tributary starts on the south side of the site and then drains northward along the west side of the site, and appears to be ephemeral. The confluence of the two tributaries is about 200 feet northwest of the overall property boundaries. An intermittent creek is on the east side of the site.

The site is along a southwest-northeast oriented ridge with no creeks through the site. Surface runoff from the site is directed to the drainage described above. Most of the site acreage drains into the Hawe Creek tributaries to the south and west as described above.

2.7 GROUNDWATER HYDROLOGY

To date no groundwater has been intercepted above the limits of the proposed mine pits. Based on data available to date, the groundwater level is estimated to be at about elevation 380 to 400 ft or lower. This is approximately 100 to 200 ft beneath the planned site facilities.

Groundwater conditions at the site are currently being evaluated in more detail. Data from groundwater monitoring well installation and from additional exploration drilling will be used to better estimate the groundwater level in the areas of the planned facilities.

2.8 GEOLOGY

Barite Hill is located in a division of the Carolina Slate Belt that extends from near McCormick southwest into Georgia. This is a belt of medium grade metamorphic rock and early to middle Cambrian volcanic, volcanoclastic, and epiclastic sedimentary rocks. It is bounded on the west by higher grade metamorphic rocks, late Precambrian volcanic and epiclastic sedimentary rocks of the Charlotte Belt, and on the east by the Modac Fault, a zone of extensive ductile shearing and mylonitization.

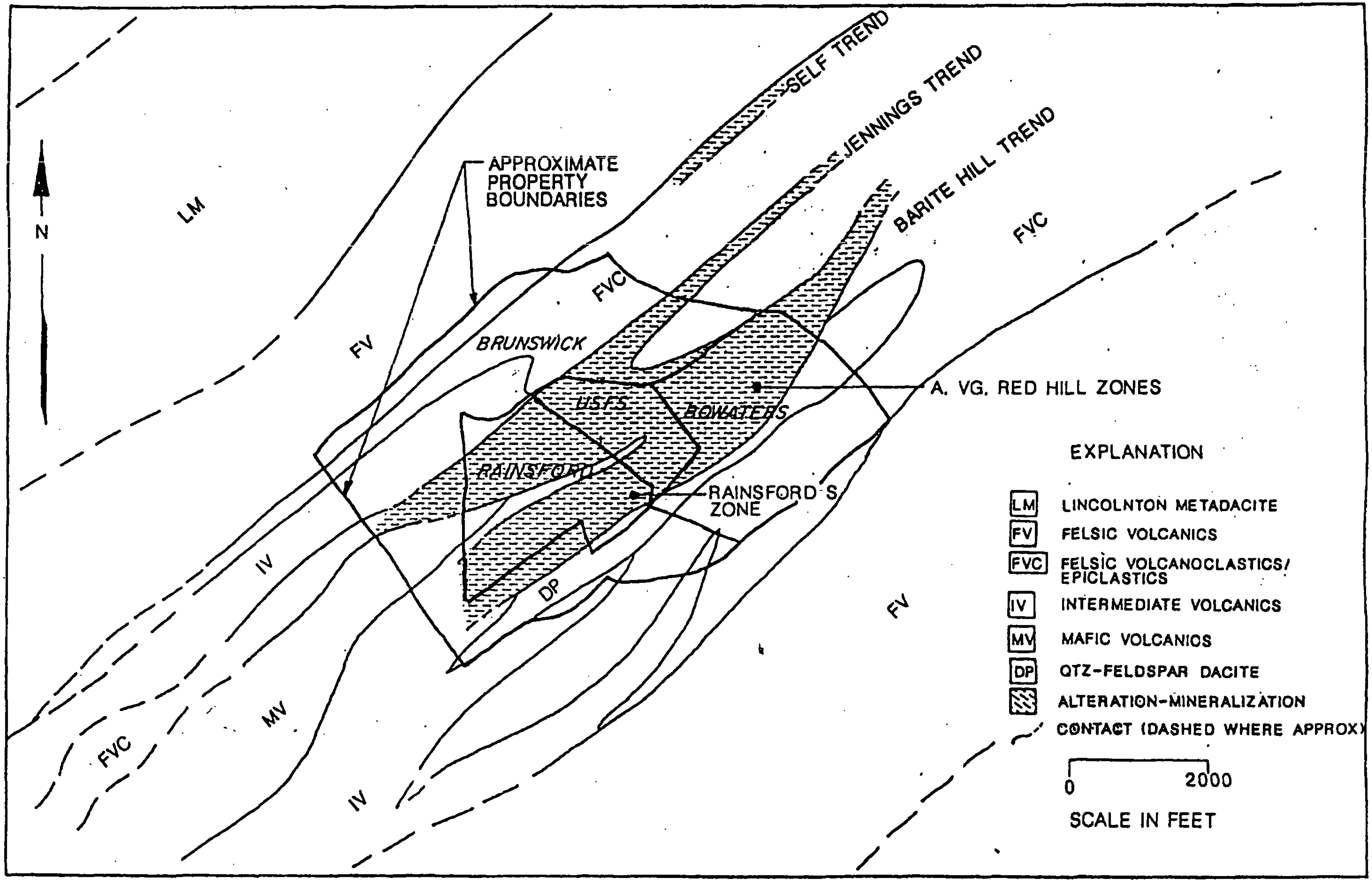
The project area lies within a stratigraphic assemblage of the Persimmon Fork Formation (Figure 2.2). This assemblage consists of basal Lincolnton Metadacite, conformably overlain by a northeast-trending sequence of metamorphosed felsic volcanics, intermediate volcanics, felsic volcanoclastics, and clastic sediments. Typical Lincolnton Metadacite is a blue quartz crystal porphyry with quartz-feldspar matrix. Felsic volcanics dominantly are comprised of quartz and feldspar crystal tuffs with a quartz-sericite matrix. Vitric and lapilli tuffs are a minor component. Intermediate volcanics are feldspar crystal tuffs with a chlorite-rich matrix. These interfinger with felsic volcanoclastics that are comprised of interstratifies felsic volcanics and clastic sediments. The clastics mostly are medium to coarse grained argillaceous sandstones, although fine-grained, laminated to thinly bedded lithologies locally are present.

The felsic and intermediate volcanics and felsic volcanoclastics display a well-developed foliation that generally strikes 55 degrees and dips 80 degrees northwest. Locally preserved bedding planes strike about 45 degrees, and commonly are subvertical to steeply northwest dipping. Stratigraphic facings, as revealed by grading and turbiditic couplets, are southeast.

2.9 SEISMICITY

A brief assessment of site area seismicity was made from published data. From charts in U. S. Army Corps of Engineers (1982b), the site is in a Zone 2 area, corresponding to a seismic coefficient of 0.05 g, where g is gravitational acceleration. The maximum rock acceleration at the site would be approximately 0.10 g, from charts published in Algermissen et al. (1982), for a 90 percent probability of not being exceeded in 50 years.

For use in design, stability analyses for seismic conditions were represented by an equivalent horizontal acceleration, or seismic coefficient. This pseudostatic type of analysis is applicable to embankments or structures that would not exhibit liquefaction or strength loss due to seismic shaking. The waste disposal areas on site would meet these conditions, being constructed



Water, Waste & Land, Inc.

FIGURE 2.2

GEOLOGY OF THE BARITE HILL AREA

Date:	MAR 1989
Project:	190

from unsaturated materials on competent foundation materials or bedrock. The seismic coefficient of 0.05 g was used in the stability analyses.

3.0 PROJECT DESCRIPTION

3.1 GENERAL

The mine facility (as currently planned) will consist of two mine pits, three mine waste disposal areas, a reusable asphalt heap leach pad, and associated process solution ponds. The location of these facilities is shown on Figure 3.1.

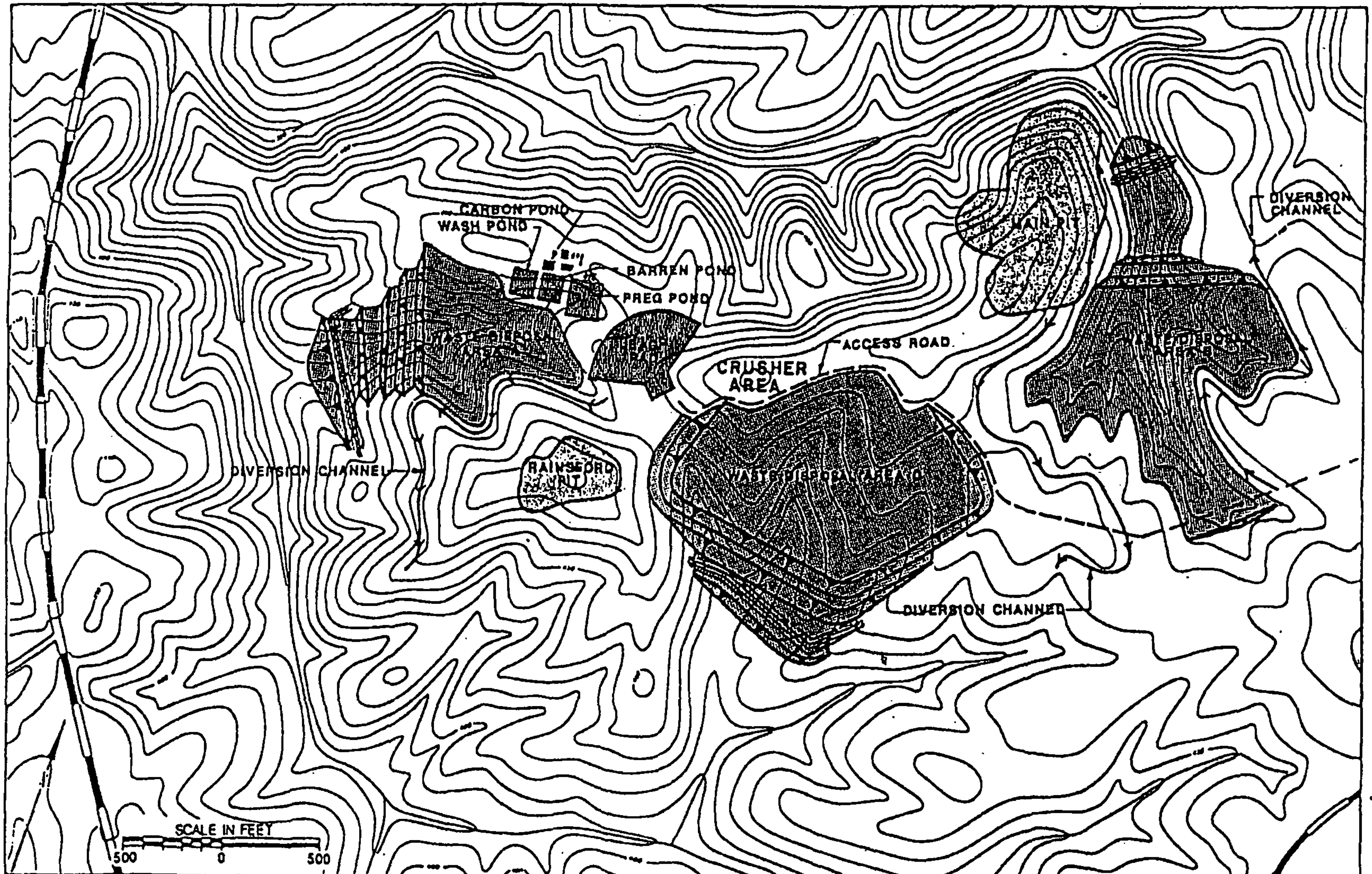
In general, the ore will be mined from the pits and then crushed and agglomerated and placed on the reusable leach pad. The diagram shown on Figure 3.2 illustrates the system operation process and directions of flow.

A cyanide solution will be pumped to the leach pad and allowed to percolate through the heaps. The pregnant leach solution flows by gravity to the bottom of each leach pad segment and into the transport channel. The transport channel conveys the solution to the pregnant solution pond, where the pregnant solution is pumped to the process plant for gold recovery. The barren solution is pumped back to the barren pond where cyanide is added and the pH is adjusted. The barren solution is pumped to the heap and flows through the ore, and the process begins again.

After the agglomerated ore has been leached, makeup or treated water is sprayed over the agglomerate until the cyanide levels are acceptable (as defined in Section 8). The leached agglomerate is then removed from the leach pad and placed in the mine waste disposal areas (along with waste rock).

3.2 MINING

The Barite Hill Mine (as currently planned) will consist of two pits, as shown on Figure 3.1. Total ore production is approximately 1.5 million tons, and total waste rock production approximately 2.4 million tons (assuming a stripping ratio of 1.6:1). The total tonnage of ore and waste rock to be produced from these pits is outlined in the table below.

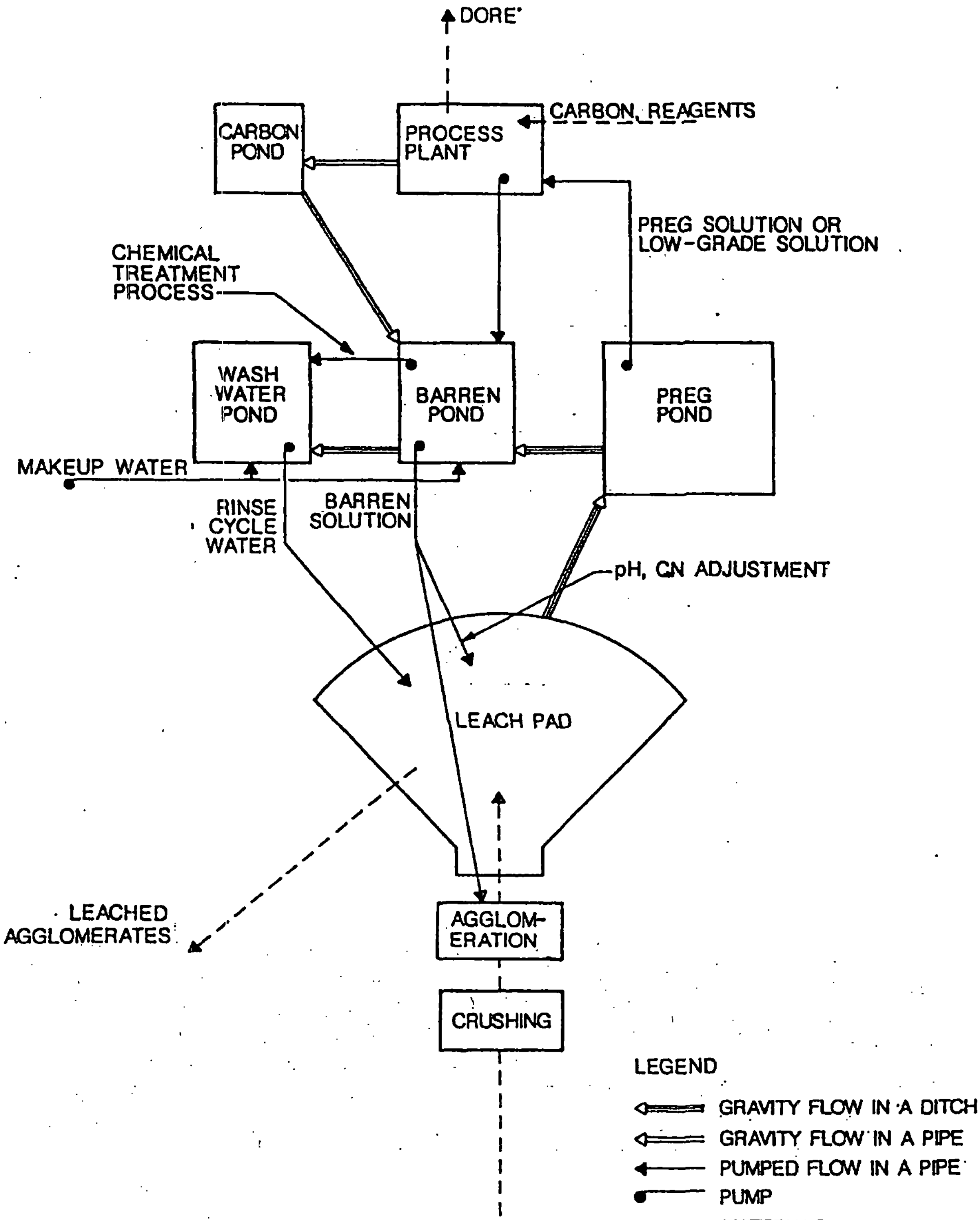


Water, Waste & Land, Inc.

Date: MAR 1989

Project: 190

FIGURE 3.1
SITE LAYOUT



Water, Waste & Land, Inc.

FIGURE 3.2
LEACH PAD AND
POND OPERATION DIAGRAM

Date: MAR 1989

Project: 190

MINE PIT	TOTAL ORE (million tons)	TOTAL WASTE (million tons)	STRIPPING RATIO	TOTAL (million tons)
Rainsford Pit	0.2	0.3	1.6:1	0.5
Main Pit	1.3	2.1	1.6:1	3.4
TOTALS	1.5	2.4	---	3.9

The anticipated mining rate is 4,000 tons of ore and waste per day. At this mining rate with the current ore reserves, the anticipated mine life is approximately three years.

Mine pits will be developed with an overall slope of approximately 1H:1V (45 degrees), with 10 ft elevation spacing between benches. Variations in slopes and benches will be made as mining proceeds for slope stability considerations. Ore will be mined by conventional methods of drilling, blasting, loading with front-end loaders, and hauling with trucks.

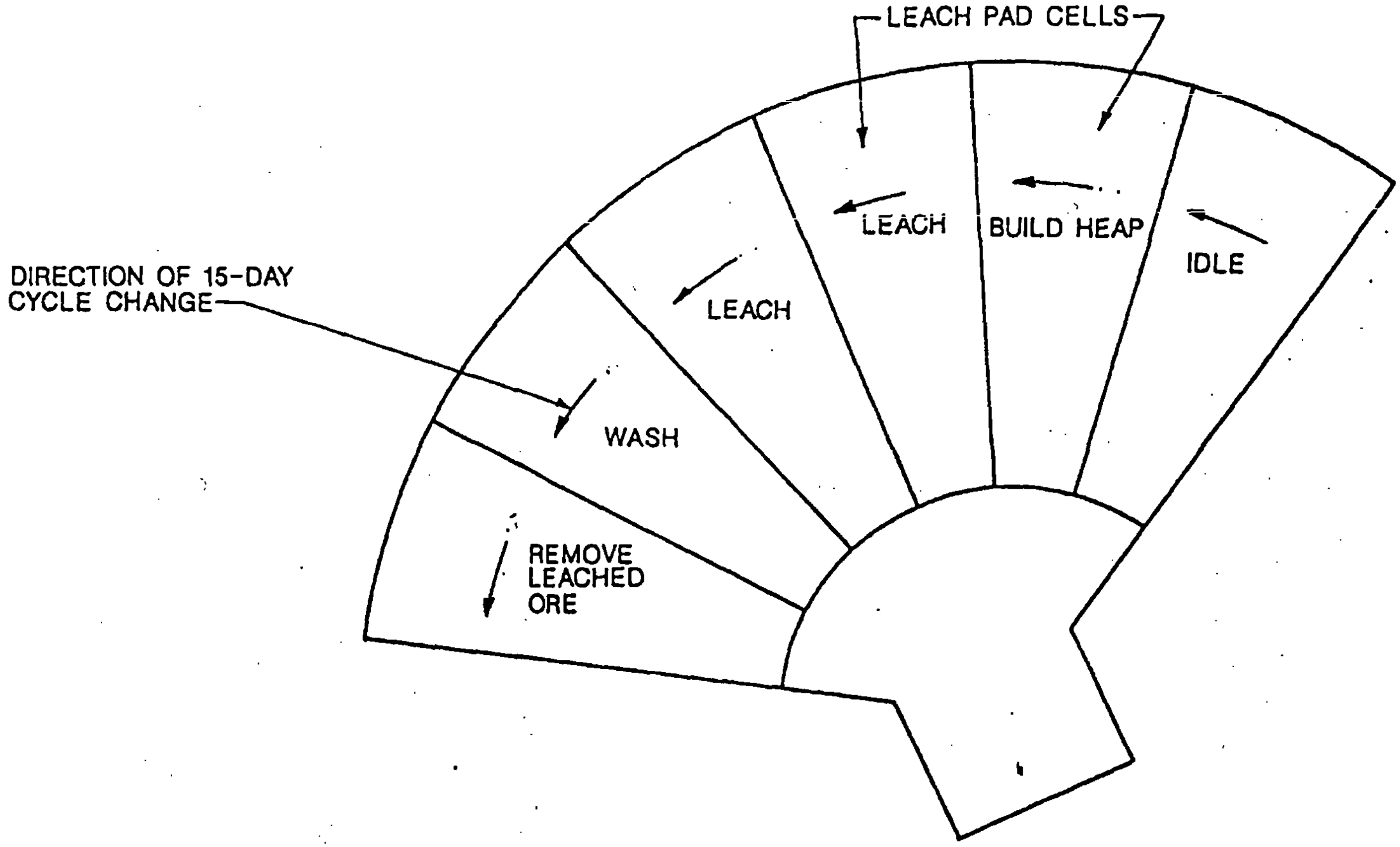
3.3 HEAP LEACHING

The ore will be crushed, agglomerated to minus one-inch size, and placed in the heaps using a conveyor and radial stacker. The crusher will process ore at an average rate of 1500 tons per day. The ore will be placed on the leach pad by the stacker in nominal lift heights of approximately 30 ft. The overall height of the heaps will be controlled by gold recovery considerations.

The leach pad will be constructed of asphalt, and will be reusable. The agglomerate will be washed and removed after the gold has been recovered and the heaps rinsed. The leaching process will be accomplished in 90 day cycles for each cell. Approximately 30 days will be used for leaching with cyanide solution, and 15 days for rinsing with wash water solution. An additional 30 days will be needed to load and unload the cells. Each cell will be idle for 15 days. Figure 3.3 illustrates the leaching schedule and proposed direction of operation.

3.4 SOLUTION APPLICATION

Leach solution to the heaps will be directed from the barren pond area using standard centrifugal or vertical turbine type pumps. This pumping system will have two pumps, only one of which will be required to maintain flow to the



NOTE: APPROXIMATELY 15 DAYS FOR EACH OPERATION

Water, Waste & Land, Inc.

FIGURE 3.3

TYPICAL LEACHING SCHEDULE

Date: MAR 1989

Project: 190

heaps. In the event of a pump failure, the alternate pump will be used. Should commercial power be interrupted, backup power will be available from generators onsite. Flow from these pumps will be monitored and totalized using standard instrumentation techniques.

Chemicals for scale prevention and standardized cyanide solution will be introduced as needed near the pump inlets. The rate of injection will be based on the solution flow rate.

Piping to the heaps will consist of polyethylene pipe meeting all applicable ASTM specifications. This piping material will be used from the pump discharge to the heaps. This material has been selected based upon several characteristics including flexibility, abrasion resistance, flow characteristics, resiliency and corrosion resistance. Polyethylene pipe can be joined by a technique known as "heat fusion", to form a strong pressure-tight joint between pipe and fittings and lengths of pipe. This relatively simple procedure produces a homogeneous joint as strong as the pipe itself without the introduction of foreign materials such as solvents or adhesives.

Solutions will be distributed to the heaps at a nominal flow rate of 0.005 gpm/sq ft primarily using sprinklers (commonly known as wobblers), or a drip tube leach system. The sprinklers provide a very uniform coverage in the 10-25 psi operating range in addition to providing a sufficiently large droplet size to minimize misting, wind drift and evaporative losses. These "wobblers" are constructed of high impact plastic and will be mounted a few inches above ground level.

3.5 MINE WASTE

Mine waste will be hauled by truck to either of three waste disposal areas (Figure 3.1). The waste disposal areas are described in more detail in Section 7. Materials placed in the waste disposal areas will be waste rock, or leached agglomerates. Mine waste characteristics are summarized in Section 4.

4.0 MINE WASTE CHARACTERISTICS

4.1 GENERAL

Two types of mine waste will be developed as a result of project operations. One is waste rock (or overburden material) excavated from the mine to expose the ore. The other waste will be the leached agglomerates (from the leach pad) after economically recoverable gold has been leached and the agglomerates have been rinsed. Since the waste rock and agglomerates are from the same geologic formations, their geochemical constituents are similar. The difference in the two materials will primarily be 1) the particle size distribution and 2) the cement content and residual leach solution concentrations (if any) in the leached agglomerates.

The two materials should be compatible for codisposal in the waste disposal areas, as proposed for this project. Below is a summary of material characteristics, based on the laboratory test data to date and proposed process operations. Once the project begins operations, representative bulk samples will be tested to confirm pertinent physical and geochemical characteristics.

4.2 PHYSICAL PROPERTIES

The waste rock will be a run-of-mine material with a varied particle size distribution. Particle sizes for this type of material (based on experience in the region) typically range from plus 6 ft down to sand and some fines (minus No. 200 sieve). Average gradations (by weight) are expected to be 100 percent minus 5 ft and less than 10 percent passing the No. 200 sieve size.

Waste rock is typically considered a cohesionless material a with friction angle of about 45 degrees (Marsal, 1973). For this project the waste rock is considered cohesionless, with the friction angle reduced to 35 degrees to account for potential variability between highly weathered strata and zones of more competent waste rock.

The ore will be crushed to a minus one-inch size with up to six percent (by weight) passing the No. 200 sieve (for unagglomerated ore). The strength parameters for the agglomerated ore are estimated to be a friction angle of 35 degrees and no cohesion.

4.3 GEOCHEMICAL PROPERTIES

Ore samples were tested for environmental-related parameters (documented in McClelland Laboratories, Inc., 1988). EP toxicity tests were conducted on washed leached agglomerate residue samples according to EPA procedures (USEPA, 1985), citric acid digestion, and deionized water washing. Metal concentrations from these tests were below maximum allowable limits in regards to EPA classification for hazardous waste.

Column leach test ore residues were washed with water for 10 days after leaching to evaluate the rinsibility of the ore. Wash solutions were analyzed for selected metals, total and weak-acid-dissolvable (WAD) cyanide. The tests indicated that water rinsing is an effective method of removing the cyanide. The tests also showed that only copper and selenium are present in any measurable amount in the wash water. Lead and mercury were not detected at all.

The waste rock is characterized as an inert material. Based on the current mine plans, the waste rock will be generated from the oxidized zone which should be a non-acid generating material.

Once mining begins, representative samples of the waste rock will be collected for additional testing.

In general, the leached agglomerates will be tested to evaluate the success of the rinse cycle, and to determine the leachability of selected chemical parameters. The waste rock will be tested for acid generation or neutralization potential and leachable metals if acid generation from the waste rock is observed.

5.0 HYDROLOGIC DESIGN

5.1 POND SIZING

Since the process is designed as a closed-loop circuit (or closed system), the ponds were sized to contain all of the water expected under conservative conditions during the operation of the facility. This volume of water would include net accumulation (or loss) of water caused by fluctuations in precipitation and evaporation, the water from the design precipitation event (100-year, 24-hour event) and the water in the system necessary for process requirements.

A water balance was performed to assess potential pond waster accumulation. This was done by summing, on a monthly basis, the water inputs (precipitation, make-up water and the moisture content of the ore) and outputs (evaporation and the moisture content of the spent ore when it is removed from the pad) to determine the net gain (or loss) of water expected under a variety of climatic conditions. Make-up water was only added to maintain a minimum volume of water in the ponds for necessary process considerations.

The precipitation and evaporation data used in the water balance analysis was from the Clark Hill Dam in South Carolina. To be conservative in sizing the ponds, monthly data from the wettest year of record was used (totaling 76.28 inches). This data is summarized below.

MONTH	WET YEAR PRECIP (inches)	AVG YEAR EVAP (inches)
JAN	9.68	0.00
FEB	5.20	2.11
MAR	8.47	3.76
APR	5.74	5.22
MAY	4.49	5.94
JUN	4.99	7.30
JUL	8.66	6.90
AUG	11.08	5.79
SEP	1.06	4.16
OCT	8.45	3.42
NOV	2.29	1.92
DEC	6.17	0.00

Evaporation from the ponds was calculated using the information presented above. The additional evaporation due to the sprinkling of the solution over the heaps was assumed to be 2 percent of the total process flow during the winter months and 4 percent of the process flow during the summer months. These evaporation rates are a conservative representation of rates experienced on similar projects.

Leachability test data indicated the in-place moisture content of the ore is approximately 4 to 5 percent, and the water retained in the washed leached agglomerate (including the water used for agglomeration) is approximately 12 to 15 percent. A net moisture loss of 8 percent was used in the water balance calculations.

The total precipitation from the 100-year, 24-hour event was determined to be 8 inches from USDA (1961). The volume of water assumed necessary for operation was assumed to be 500,000 gallons (the process rate of 350 gpm for 24 hours). In addition, a volume of water that would drain from the heaps was included in the pond sizing calculations. This volume was calculated to be 250,000 gallons (the process flow rate of 350 gpm for 12 hours).

A summary of the pond sizing analysis is presented below. Appendix C contains a complete presentation of the calculations.

SIZING CRITERIA	VOLUME (acre-ft)	VOLUME (million gal)
100-YR, 24-HR EVENT (8 in. x process/pond area)	3.0	1.00
OPERATING VOLUME (350 gpm x 24 hrs)	1.5	0.50
DRAINDOWN VOLUME (350 gpm x 12 hrs)	0.8	0.25
WATER BALANCE REQUIREMENT (Maximum accumulation during the life of the project)	3.0	1.00
TOTALS	8.3	2.75

The final pond sizes included capacity for two ft of freeboard in addition to the maximum volume conditions outlined above.

5.2 DIVERSION CHANNEL DESIGN

Three diversion channels ditches will be constructed to divert or direct flow from undisturbed areas away from the leach pad and waste disposal areas. These channels, shown on Figure 5.1, were sized for peak runoff from the 100-yr event.

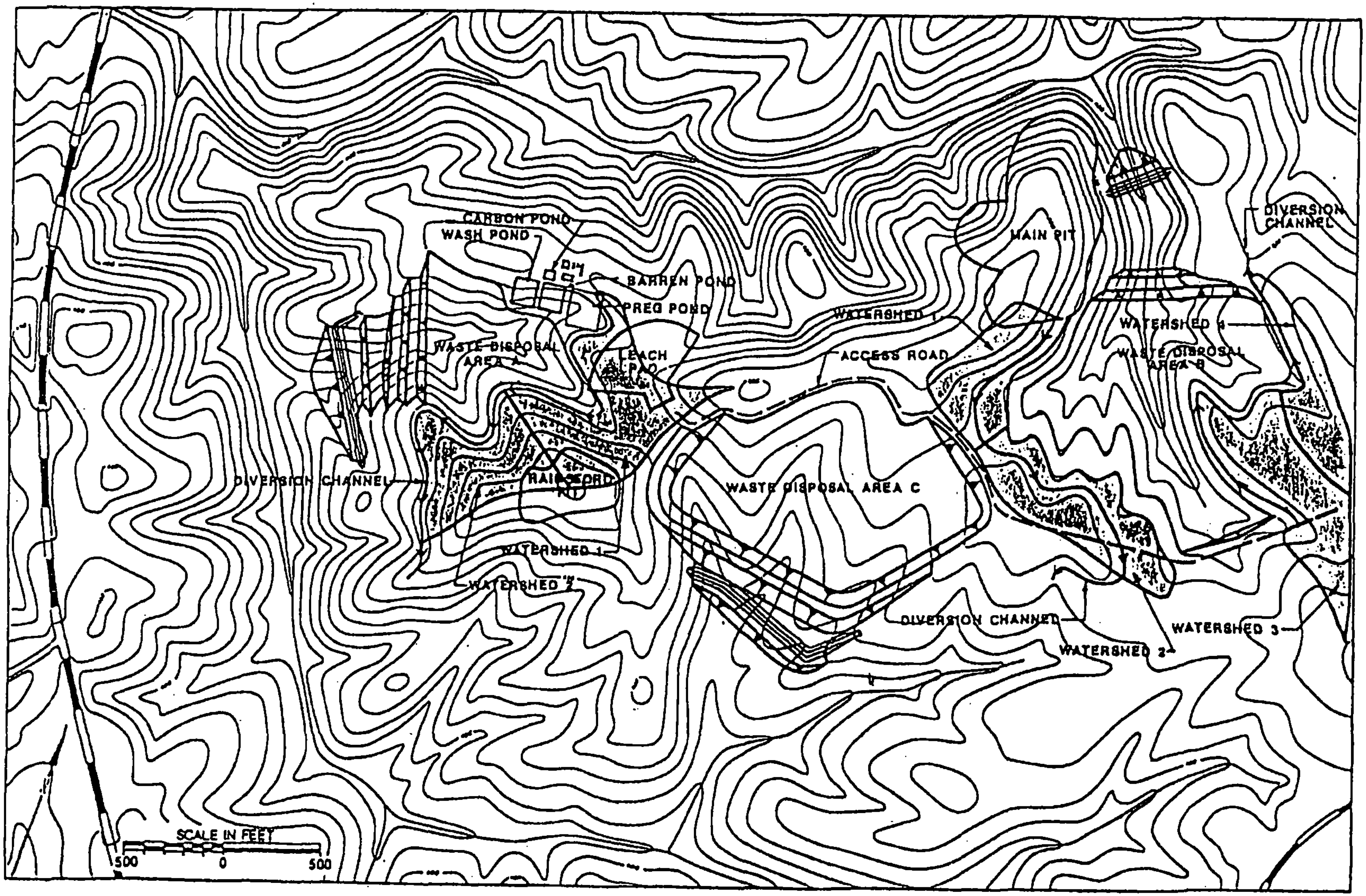
Peak runoff was estimated in the major catchments in the site area under current conditions (prior to mining activities). The major catchments are shown on Figure 5.1.

Peak runoff was evaluated with the HEC-1 program (U.S. Army Corps of Engineers, 1985), using assumed parameters listed in the table below. Curve numbers used in the evaluation were based on Antecedent Moisture Condition II and soil groups representative of the soils in the site area. Peak flows from the 100-yr event are presented below.

WASTE DISPOSAL AREA	WATERSHED	AREA (sq ft)	AREA (sq mi)	AVERAGE LENGTH (ft)	SLOPE (%)	CN	LAG-TIME (hr)	PEAK FLOW (cfs)
A	1	427,300	0.0153	800	10.2	77	0.09	77
	2	308,650	0.0111	850	13.3	77	0.08	116
B	1	255,425	0.0092	400	9.0	77	0.06	49
	2	397,075	0.0142	400	4.7	77	0.08	109
	3	435,438	0.0156	1400	3.3	77	0.25	58
	4	202,388	0.0073	1250	3.3	77	0.23	81

Velocities and depths of flow at selected ditch cross sections were calculated with the HEC-2 program (U.S. Army Corps of Engineers, 1982a).

The analyses show the south diversion channel from Site A would have a peak discharge of 116 cfs. The channel will have a bed slope of 0.25 percent. The



Water, Waste & Land, Inc

Date:	MAR 1989
Project:	190

FIGURE 5.1
LOCATION OF MAJOR CATCHMENT AREAS AND DIVERSION CHANNELS

peak velocities range from 2.0 to 2.8 ft/sec with the maximum depth of flow ranging from 2.0 to 2.5 ft.

The analyses show that the west diversion channel from Site B would have a peak discharge of 109 cfs. The channel will have a bed slope of approximately 0.25 percent. The peak velocities range from 2.0 to 5.4 ft/sec with the maximum depth of flow ranging from 1.1 to 2.0 ft.

The analyses for the east diversion channel from Site B indicated that the peak discharge would be 81 cfs, with peak velocities in the range of 1.6 to 2.7 ft/sec. The slope of the channel will be 0.25 percent. The maximum depth of flow ranges from 1.6 to 2.5 ft.

Given the depths of flow above, all channels will have the same cross-sectional geometry. The ditches will be trapezoidal in section with a bottom width of 10 ft, 3H:1V side slopes and a depth of 3 ft. This typical cross-section is shown on Figure 5.2.

5.3 TRANSPORT CHANNEL DESIGN

An asphalt lined channel will be constructed around the perimeter of the leach pad. This channel will convey the process solution from the leach pad to the pregnant solution pond. In addition to being able to transport the process flow, the channel was designed to be large enough to convey the flow during the 100-yr event. The process flow will be approximately 350 gpm (0.7 cfs). The HEC-1 analysis indicates the peak flow during the design storm will be 40 cfs.

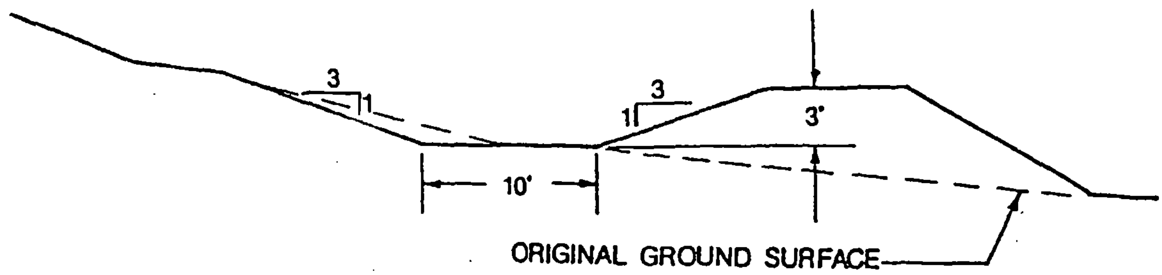
Because of the asphalt paving equipment, the channel will have both bottom and sides are 10 ft in slope length. The side slopes will be 3H:1V (Figure 5.2). Given this configuration, the transport channels will have a total depth of approximately 3.2 ft. HEC-2 analyses of the channel under a total peak flow of 40 cfs indicates the maximum depth in the channel will be 0.8 feet. Because of the small depth of flow, especially during normal operating conditions, the bottom of the channel will be canted away from the pad at a slope of approximately 2 percent to concentrate flow.

5.4 SEDIMENT CONTROL STRUCTURES

Sediment is expected to be generated during the operational life of the project. The major source of the sediment will be from the waste disposal areas. The plant area is drained to the ponds and surface water will not be discharged from the pit area. In order to control sediment discharge from the site, the

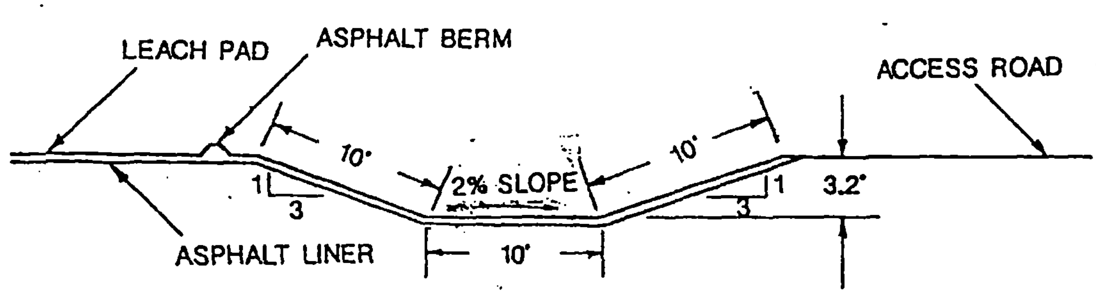
TYPICAL DIVERSION CHANNEL

CROSS - SECTION



TYPICAL TRANSPORT CHANNEL

CROSS - SECTION



SCALE: 1"=10'

Water, Waste & Land, Inc.	FIGURE 5.2 TYPICAL CHANNEL CROSS - SECTIONS	Date: MAR 1989 Project: 190

waste disposal areas were designed to minimize surface runoff and provide for runoff retention.

Each of the three waste disposal areas will drain to the lowest bench at the downstream toe of each area. Each of these benches will have a berm to temporarily retain storm runoff. The height of the berms and the area of the lower benches were designed to contain all of the runoff from a 100-yr, 24-hr event. This containment volume is significantly larger than the required retention of runoff from the 10-yr, 24-hr event. The volume of water for which the retention benches were designed is summarized below:

Disposal Area A	10.0 acre-ft
Disposal Area B	20.2 acre-ft
Disposal Area C	15.6 acre-ft

The lower portion of each disposal area will be constructed of coarse durable waste rock to maintain a low phreatic surface and to aid in the drainage of the toe area. It is estimated that the retention benches would take approximately two days to drain if they were filled to total capacity.

In addition, to provide an extra factor of safety, overflow channels were designed to pass the peak flow if a 100-yr, 24-hr event were to occur when the retention benches were full. The overflow channels would divert flow around the berms to prevent overtopping. The peak flows were determined from HEC-1 analyses, and are summarized below.

Disposal Area A	66 cfs
Disposal Area B	54 cfs
Disposal Area C	108 cfs

The channels for disposal areas A and B will be trapezoidal in section, 2 ft deep with a bottom width of 10 ft and 3H:1V side slopes. The overflow channel for disposal area C will be 2 ft deep with a bottom width of 20 ft and 3H:1V side slopes.

A more detailed presentation of the hydrologic analysis for the waste disposal area retention benches is presented in Appendix C. A more detailed description of the waste disposal areas is given in Section 7.

6.0 HEAP LEACH FACILITY DESIGN

6.1 GENERAL ARRANGEMENT

The general arrangement of the heap leaching and recovery facilities is shown on Figure 6.1. The pad will be a reusable asphalt lined pad divided into six cells. The pad will drain into an asphalt-lined transport channel, which drains by gravity to the pregnant solution pond. The pregnant solution pond is connected to the barren pond and the wash water pond by lined spillway channels.

6.2 LEACH PAD AND TRANSPORT CHANNEL

The layout of the leach pad is shown on Figure 6.2. Details of the transport ditch are shown on Figure 6.3.

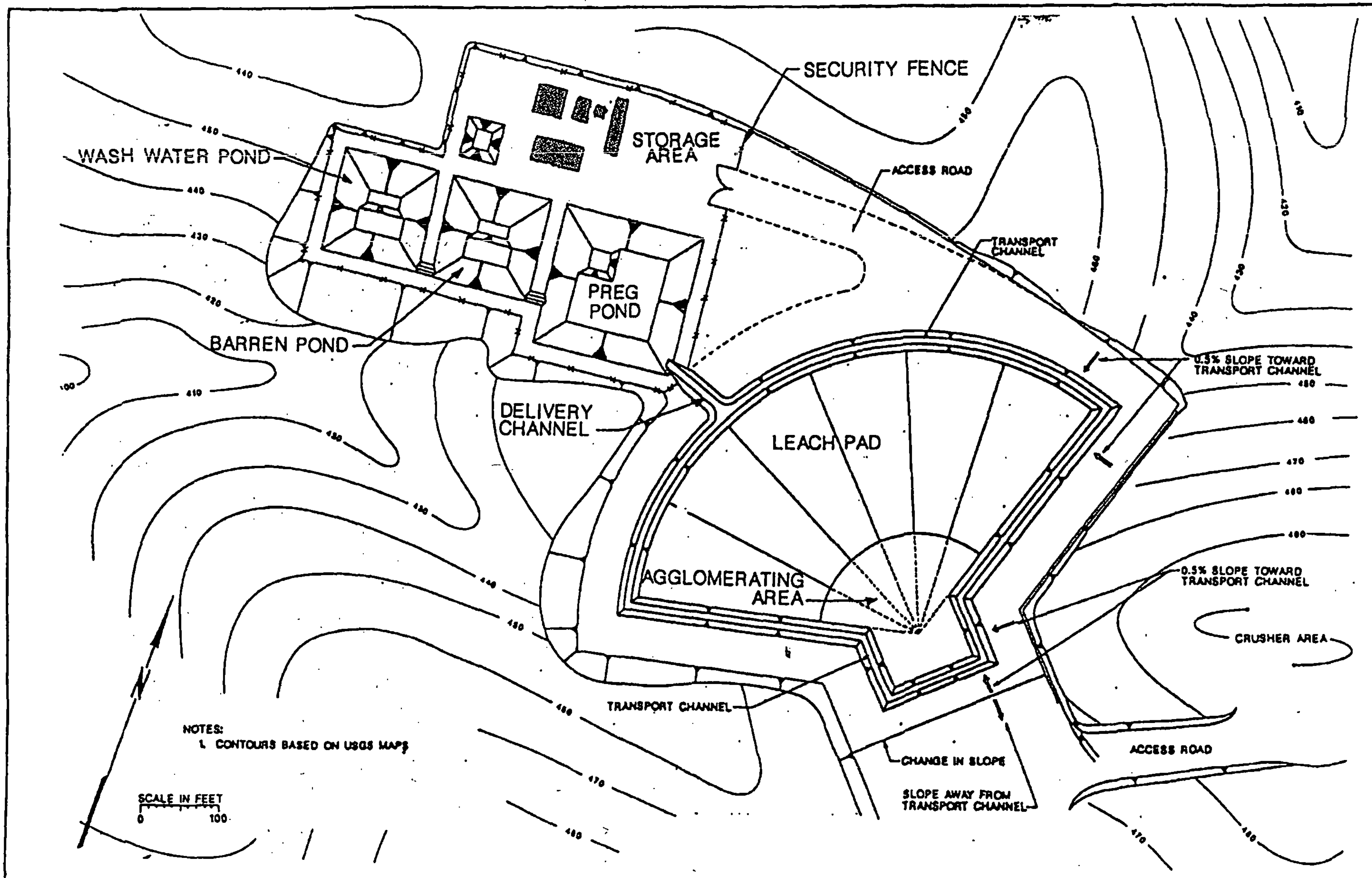
The leach pad will consist of six cells arranged in a radial pattern. Each cell segment is approximately 235 ft long, with an inner arc length of 50 ft and an outer arc length of 130 ft. Each cell has an area of approximately 0.7 acres. The cell configuration was chosen to best accommodate heap construction with a radial stacker.

The leach pad will have a relatively planar surface with no grade breaks, with cells sloping approximately four percent down the fall line and approximately 1/2 percent perpendicular to the fall line. Asphalt berms, approximately 8 inches high will be constructed around each cell to control the rinse and leach solutions from each cell.

The cells will drain into an asphalt transport ditch located along the outer edge of the pad. The transport channel will consist of a ten-ft wide bottom with ten-ft wide side slopes (measured along the slope). The bottom of the ditch will be canted away from the pad at approximately 2 percent. The overall slope of the channel will be is 0.5 percent towards the pregnant solution pond delivery ditch. The sides of the transport channel will be sloped at 3H:1V, with the exception of the area around the agglomeration and stacker. In this area, the side slopes of the ditch will be 10H:1V to allow truck access onto the pad.

6.3 FOUNDATION CONDITIONS

The leach pad will be constructed over a cut-and-fill area. In general, the east side of the pad will be on the cut, and the west side will be on compacted fill. The maximum cut is approximately 7 ft and the maximum fill is

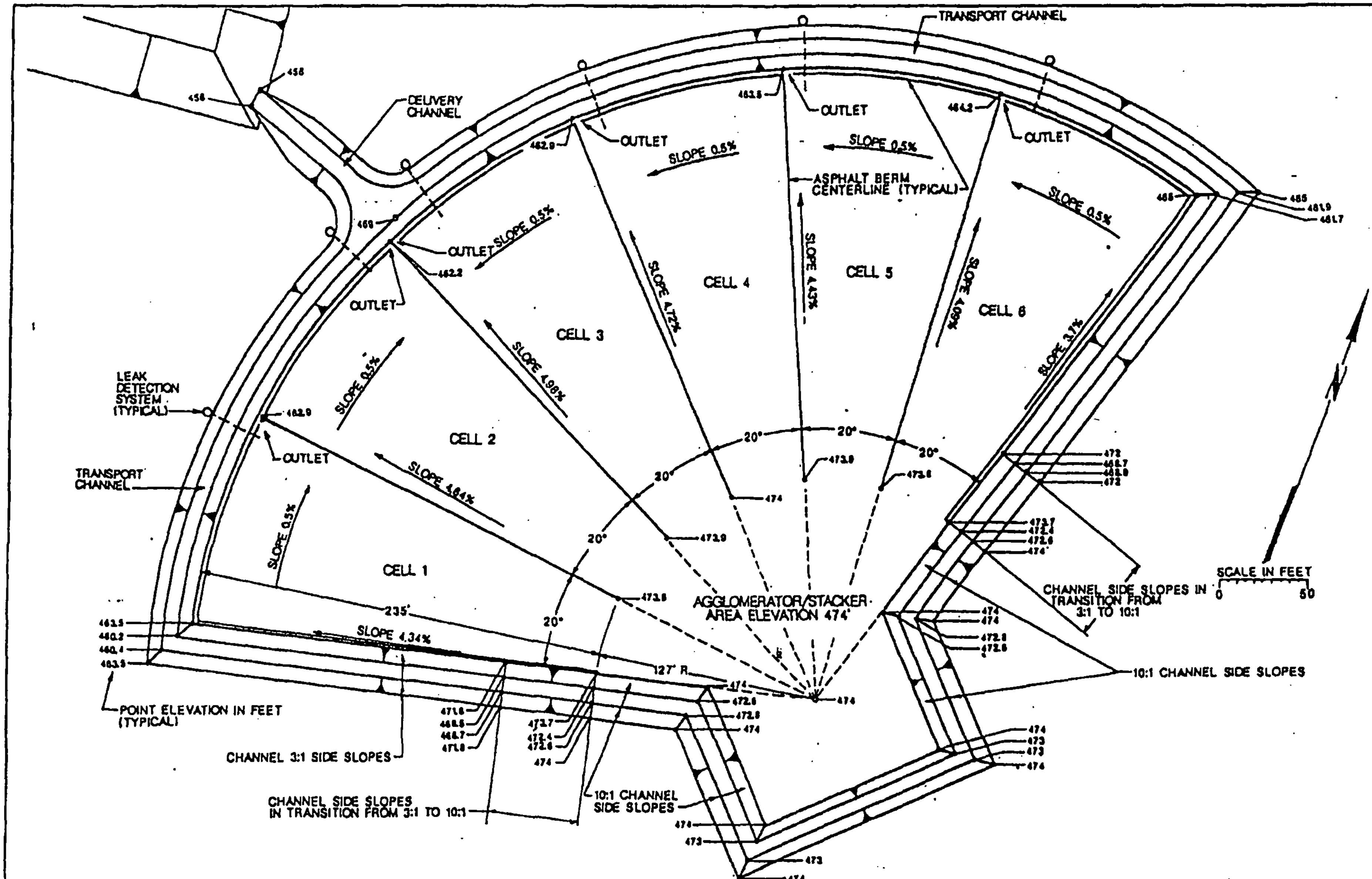


Water, Waste & Land, Inc.

FIGURE 6.1

GENERAL LAYOUT OF HEAP LEACH FACILITIES

Date:	MAR 1989
Project:	190

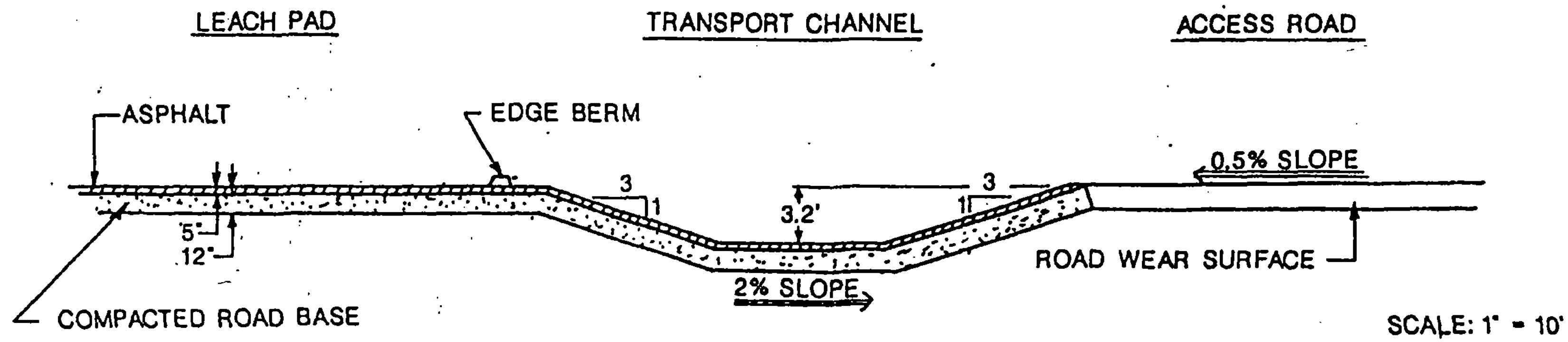


Water, Waste & Land, Inc.

FIGURE 6.2

LEACH PAD LAYOUT

Date:	MAR 1989
Project:	190



Water, Waste & Land, Inc.

FIGURE 6.3
TRANSPORT CHANNEL DETAIL

Date:	MAR 1989
Project:	190

25 ft. Approximately 32,000 c.y. of fill and 2,000 yd c.y. of cut will be necessary for leach pad preparation. The leach pad elevations were chosen to provide acceptable foundation conditions, minimize excavation of hard rock, and minimize the volume of earthworks required for subgrade preparation.

Native material will be used for compacted fill where necessary to bring the subgrade elevation to within 1 ft 5 in. of the final elevations as shown on the Drawings. The native material will be placed in one-ft thick lifts and compacted to 95 percent of Modified Proctor density.

A woven geotextile (Mirafi 600X or equal) will be placed over the compacted fill. One foot of road base material compacted to at least 95 percent Modified Proctor density will then be placed over the geotextile.

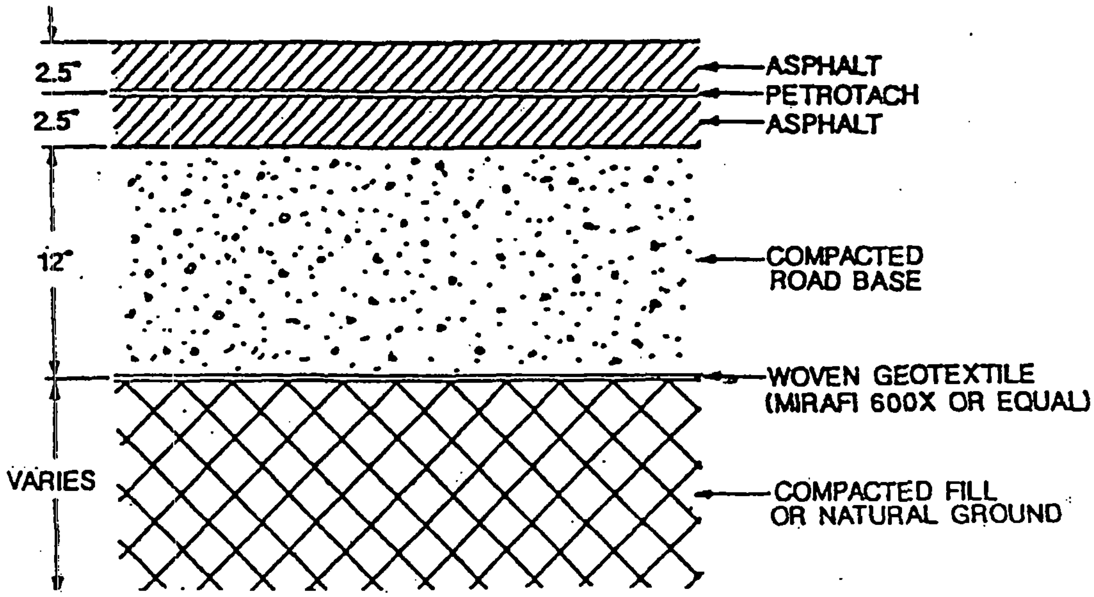
The asphalt pad will then be placed over the compacted road base material. A typical detail of the pad section is shown on Figure 6.4, which shows a 5-inch thick asphalt pad placed in two lifts separated by Petrotac.

6.4 PAD LEAK DETECTION SYSTEM

The leak detection system for the leach pad will consist of slotted pipe bedded in the road base material beneath the transport channel and leach pad (Figure 6.5). The pipe will discharge into a sump. A separate leak detection system will be used for each cell of the leach pad, so that if a leak were to occur, the location of the leak could be identified by cell, and appropriate action taken.

The leak detection system pipe will consist of slotted drain pipe bedded in road base material under the transport ditch at the bottom of each segment of the leach pad. Sufficient differences in permeability should exist between the road base material and underlying compacted soils to provide a barrier for downward migration of moisture at the bottom of the road base material. Outside of the road base, blank pipe will convey any fluid collected into the slotted pipe to the leak detection sump.

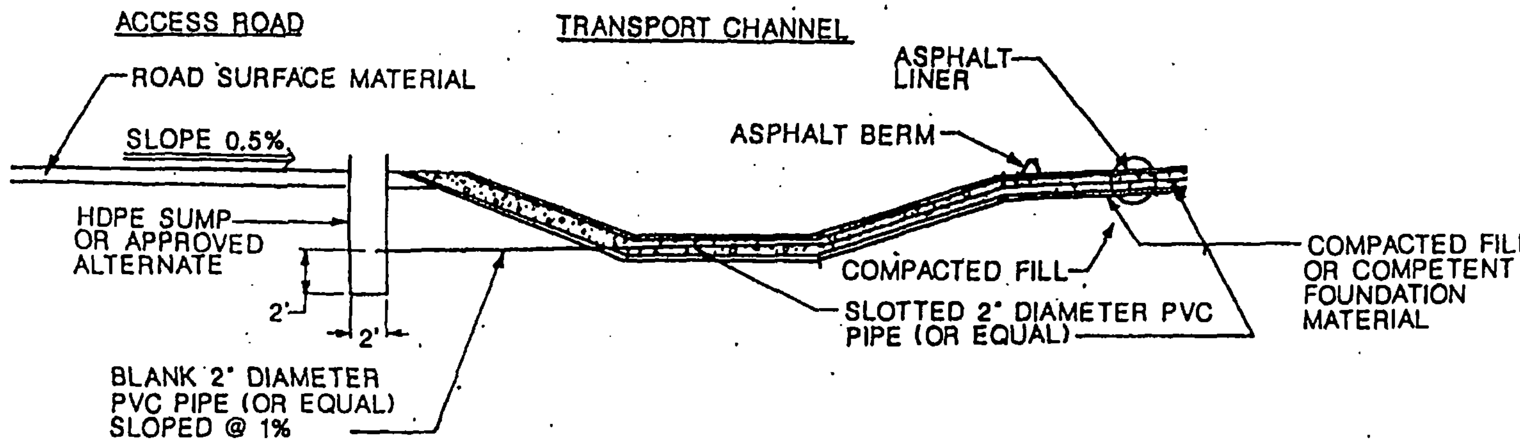
If a leak were to occur, the fluid would flow in the road base material, down the slope and be collected in the road base material under the transport channel. If there was sufficient volume of fluid, it would then collect in the leach collection drain and slotted pipe and be transmitted by blank pipe to the sump.



Water, Waste & Land, Inc.

FIGURE 6.4
ASPHALT DETAIL

Date:	MAR 1989
Project:	190



Water, Waste & Land, Inc.

FIGURE 6.5

LEAK DETECTION DETAIL

Date:	MAR 1989
Project:	190

6.5 HEAPS

The crushed and agglomerated ore will be placed on the leach pad by way of a tire-mounted stacker. The agglomerated ore will be stacked to nominal height of approximately 30 ft. The side slopes of the agglomerate will be at the angle of repose. The agglomerate will be leached and washed on the leach pad, then removed and transported by loaders and trucks to the mine waste disposal areas.

Slotted PVC or ADS drain pipes will be placed on the leach pad prior to agglomerate stacking in order to enhance heap drainage and slope stability. The leach pad slopes and drain pipes will aid in keeping any zone of saturation in the heaps as low as possible.

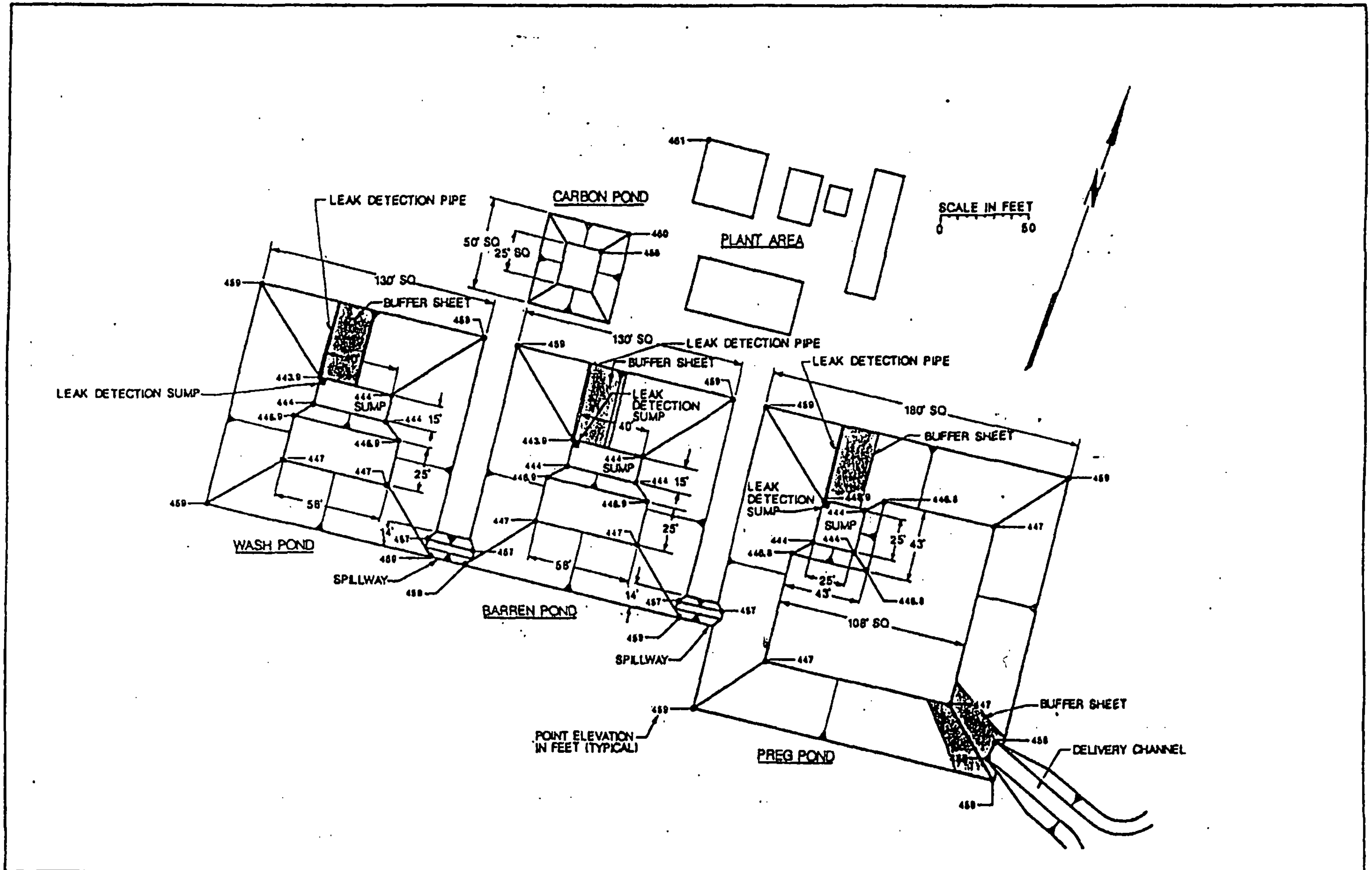
The stability of the heaps was evaluated under operating conditions. Although some minor surface ravelling may occur (due to the ore stacked at angle of repose), the friction angle is sufficiently high between the agglomerate and asphalt to preclude large heap failures, assuming no significant buildup of a zone of saturation in the heap. The asphalt transport channel provides an additional buffer area (approximately 30 ft wide) around the heaps.

6.6 SOLUTION PONDS

Three solution ponds will be constructed at the west end of the leach pad and adjacent to the processing plant (Figure 6.6). They are the pregnant solution pond, the barren solution pond, and the wash water pond. Dimensions and capacities of the three major ponds are shown below. The pond sizing calculation are summarized in Section 5.

Pond	Preg	Barren	Wash Water
Capacity (million gallons)	1.37	0.69	0.69
Depth (ft)	12	12	12
Top Dimensions (ft x ft)	180 x 180	130 x 130	130 x 130

A fourth pond (carbon pond) will be 50 x 50 ft and 4 ft deep. This pond is located near the plant for carbon separation from the barren solution. The storage capacity of the carbon pond was not included in the total pond capacity calculation.



Water, Waste & Land, Inc.

FIGURE 6.6

POND PLAN

Date: MAR 1989

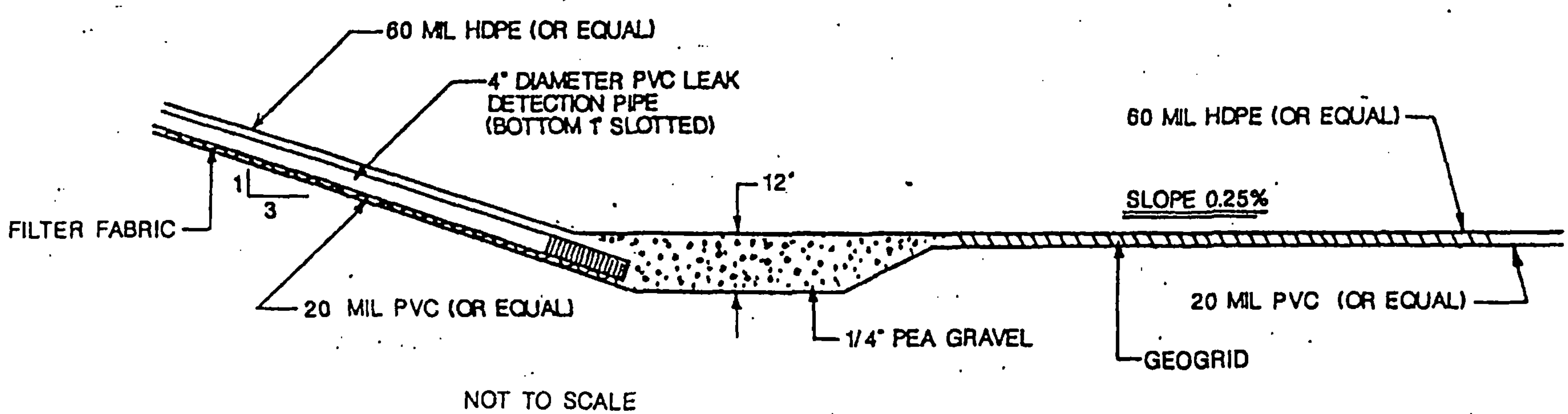
Project: 190

The three major ponds and associated inlet and outlet works have been designed to accommodate operating conditions and the 100-yr, 24-hr event while still maintaining two ft of freeboard (Section 5). Pond side slopes will be 3:1, and pond bottoms will be sloped or shaped to drain toward a three-ft deep sump. The storage capacity of the sumps were not included in the total pond capacity calculations.

The ponds will have a double synthetic liner. The top (or exposed) liner will consist of 60-mil thick HDPE (or equal), and the bottom liner will consist of 20-mil PVC (or equal). A geodrain drainage layer will be placed between liners along the bottom of the ponds, and filter fabric will be placed between the liners along the sides of the ponds. At the low part of the sump, a one-ft thick layer of pea gravel will be placed between the liners to provide a leak detection sump.

Figure 6.7 shows a typical pond cross-section with the leak detection system between liners. There will be a separate leak detection system for each pond.

In addition to the double pond liner system, a sheet of 60 mil liner will be installed over the outer liner in areas where abrasion may occur. This additional liner (or buffer sheet) will be installed in the pregnant solution pond where the solution enters the pond and under each of the suction lines where they rest against the liner (Figure 6.6).



Water, Waste & Land, Inc.

FIGURE 6.7
POND BOTTOM AND LEAK DETECTION DETAIL

Date: MAR 1989

Project: 190

7.0 MINE WASTE DISPOSAL AREAS

7.1 GENERAL

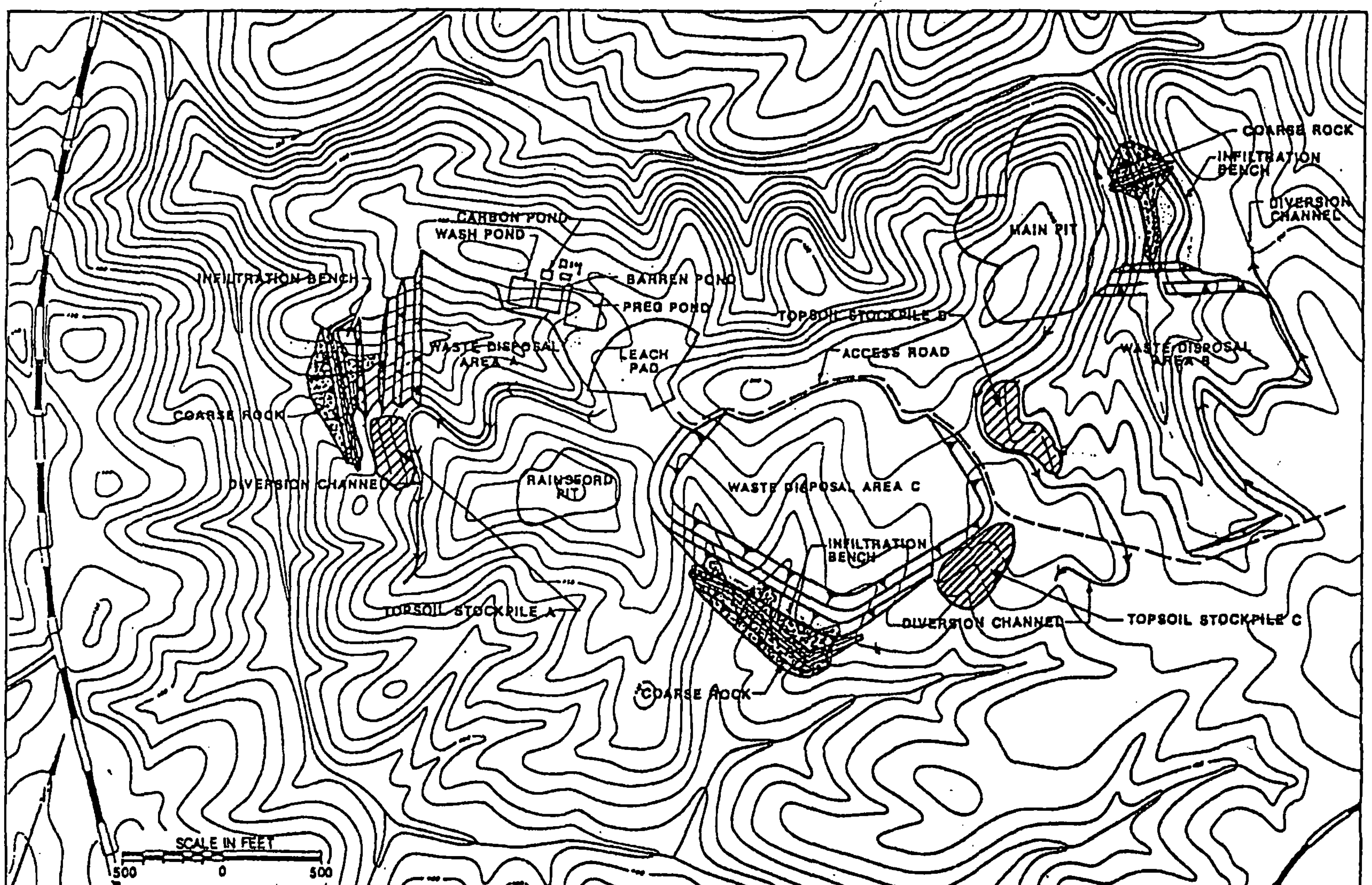
Three waste disposal areas, located as shown on Figure 7.1, will contain the waste rock as well as the leached agglomerate removed from the pad. In addition to these areas, waste rock and leached agglomerate will be placed in the Rainsford Pit once mining is completed in the pit.

The required volume for waste disposal is summarized in the table below. The total capacity of the areas (including the Rainsford pit) are designed to contain 3.9 million tons (2.4 million cubic yards) of material. Waste Disposal Area A will contain 0.87 million tons; Area B, approximately 1.0 million tons; Area C, approximately 1.73 million tons; and Area D (Rainsford Pit), approximately 0.3 million tons.

SITE	TOP ELEV (FT)	MATERIAL SOURCE	MATERIAL QUANTITY[a] (million tons)	DESIGN CAPACITY (million tons)
A	450	Rainsford Pit Waste + Leached Agglomerates	0.30+ 0.5	0.87
B	460	Main Pit Waste	1.00	1.00
C	490	Main Pit Waste + Leached Agglomerates	1.10 + 0.63	1.73
D	490	Leached Agglomerates	0.30	0.30
		TOTALS	3.90	3.90

[a]Material quantities:
Leached agglomerates - 1.5 million tons
Main Pit waste - 2.1 million tons
Rainsford Pit waste - 0.3 million tons

The disposal areas will be constructed to have final outside slopes of 3H:1V with minimum 50-ft wide benches. Runoff from natural areas above the disposal areas will be diverted as much as possible.



Water, Waste & Land, Inc

Date: MAR 1989
Project: 190

FIGURE 7.1
LAYOUT OF MINE WASTE
DISPOSAL AREAS

Runoff from each disposal area will be controlled and retained on the lower bench of the disposal area for sediment control. This retention structure is illustrated by the typical waste disposal area cross-section of Figure 7.2.

7.2 SITE PREPARATION

Initial waste disposal area preparation will consist of clearing and grubbing the area and stripping of topsoil. It is anticipated that approximately 12 inches of suitable soils will be stripped and stockpiled in designated areas for reclamation after the project is completed. Three topsoil stockpiles areas have been identified, as shown on Figure 7.1.

In addition, some site grading will be necessary for the construction of the haul roads from the pits and the leach pad areas, and for diversion channel construction. Since the distances to the waste disposal areas is small, this will be a minor activity.

Water bars or other runoff control structures will be constructed as needed in the prepared waste disposal sites to control erosion and sediment generation.

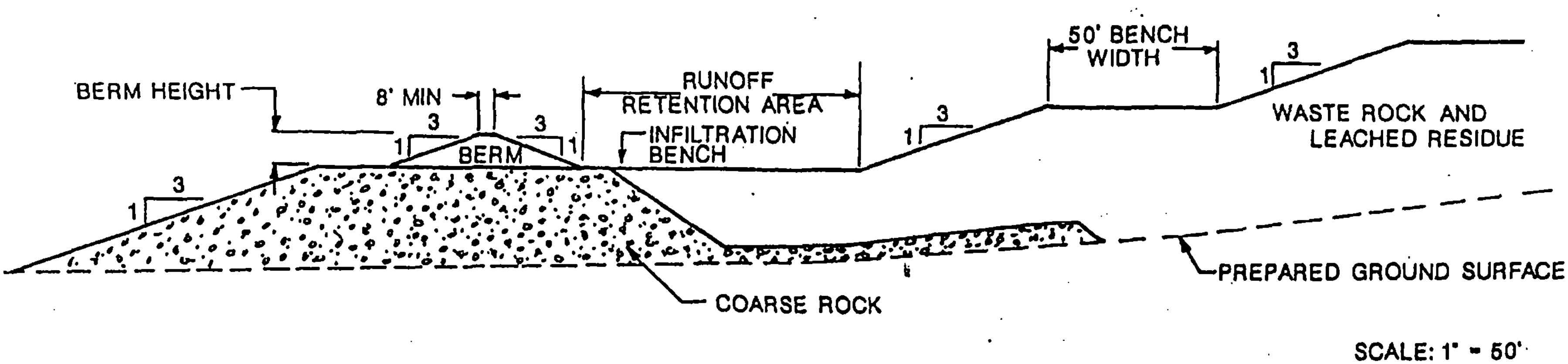
7.3 DISPOSAL AREA CONSTRUCTION

Following site preparation, one of the first components of the waste disposal area to be constructed will be the lower benches (depending on material availability). These benches will be constructed of durable, coarse waste rock and will serve as areas for runoff retention and infiltration. The size of the benches, along with the height of the berm along the edges of the lower bench, were designed to contain runoff during a 100-yr, 24-hr event (as presented in Section 5).

In addition to coarse material being placed at the toe of the waste disposal area to form the lower bench, coarse durable waste rock will also be used to fill the lower portion of the bottom of the existing gullies. This coarse material will facilitate rapid drainage of the waste disposal areas. Except for the two areas discussed above, the waste will not be segregated, sorted, or otherwise kept separate.

The waste material will be end-dumped in lifts up to 50-ft high. The face of each lift will be at the angle of repose of the material. The toe of each successive lift will be set back a sufficient distance to accommodate grading the final face to a 3H:1V slope, according to reclamation requirements.

RETENTION BERM HEIGHT TABLE	
WASTE DISPOSAL AREA	BERM HEIGHT (FT)
A	7
B	6
C	10



Water, Waste & Land, Inc.

FIGURE 7.2
TYPICAL SECTION THROUGH TOE OF
WASTE DISPOSAL AREA

Date: MAR 1989

Project: 190

The top surface of each lift will be compacted and graded to control runoff and minimize infiltration. Compaction will be achieved by making a minimum of one complete pass over the surface trucks, or other suitable equipment. The surface will be graded to route surface runoff away from the working face and to minimize erosion of the dump material.

The final disposal area surface will have a minimum 12-inch thick layer (below two feet from the surface) that will be compacted to 100 percent of Standard Proctor density. The final disposal area surfaces will then be covered with eight inches of reclamation soil and seeded (as described in Section 9).

7.4 SLOPE STABILITY

The mine waste disposal areas were analyzed for stability under critical conditions of construction and operation. Stability was analyzed by evaluating two-dimensional sections through the disposal areas that would be the most critical for stability.

The conditions that were analyzed were the final configuration of disposal Area B and the final configuration of disposal Area C. The stability of the initial configuration of the disposal areas was not as critical as that of the final configurations. These slopes were analyzed because they represent the most critical conditions for slope stability.

Stability was analyzed for both static and seismic conditions. Seismic conditions were represented in pseudostatic analyses by an equivalent horizonal acceleration or seismic coefficient of 0.05 g. The selection of the seismic coefficient from published seismicity data is described in Section 2.9.

The results of the stability analyses indicate that the disposal areas will be stable with the 3H:1V slopes and benches under both static and seismic conditions. A factor of safety of 1.5 under static conditions and 1.1 under seismic conditions was the minimum criteria for both short-term and long-term stability. The minimum calculate factors of safety for the sections that were analyzed were 1.5 under static conditions and 1.25 under seismic conditions. Complete results are presented in Appendix C.

8.0 OPERATION AND MONITORING

8.1 GENERAL

Monitoring procedures will be developed based on permit requirements. These procedures will include provisions for site monitoring, process component monitoring, and process material monitoring.

8.2 SITE AND COMPONENT MONITORING

Site monitoring will primarily consist of observation of the leak detection systems beneath the leach pads and solution ponds. These systems are described in Section 6.

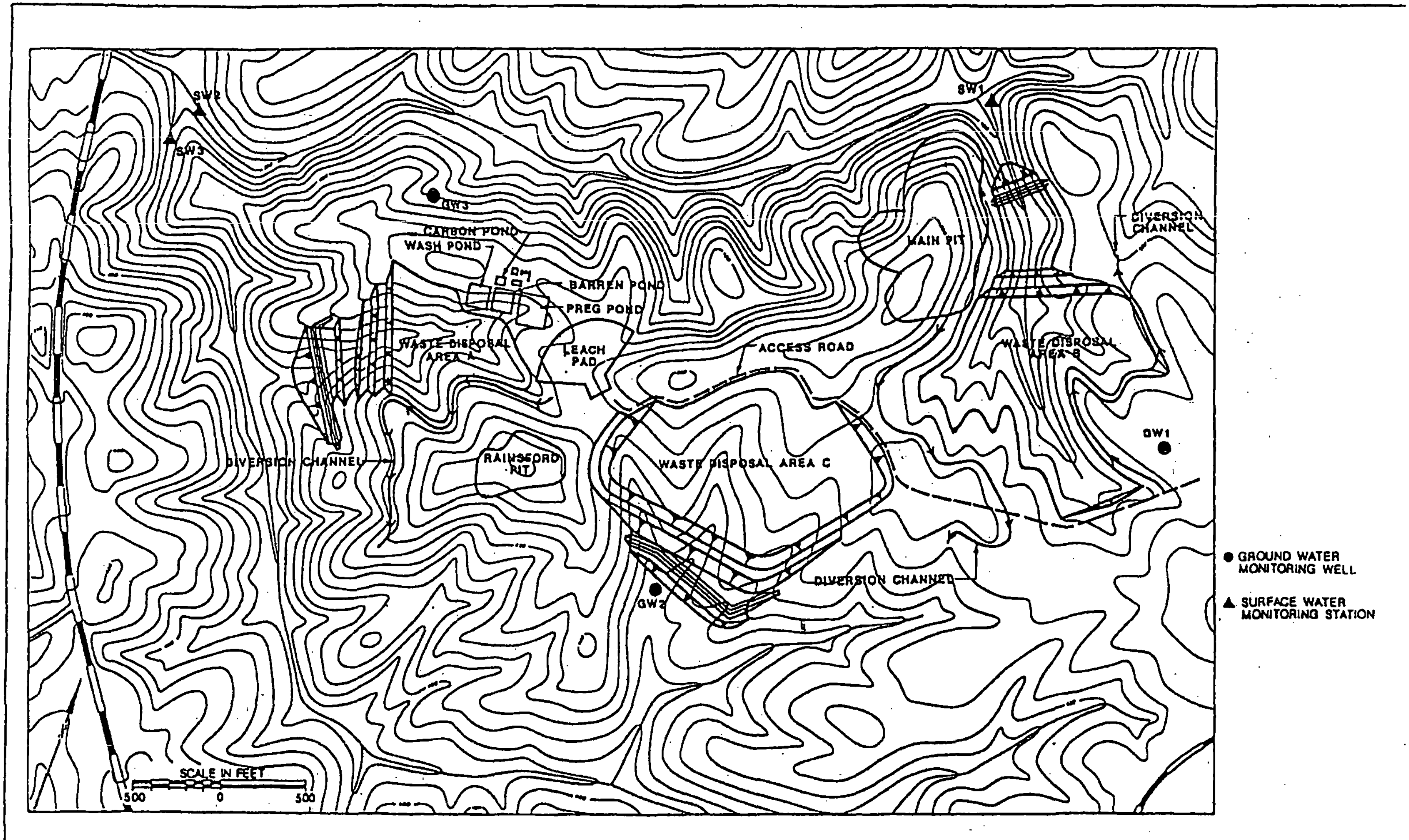
In addition, two levels of site monitoring will be carried out as part of the project operations. The first level is the sampling of solutions and material on the leach pad during rinsing and removal operations. The second level is field monitoring of the disposal area under the current project water quality monitoring program.

Water quality samples will be collected on a quarterly basis from the ground water and surface water sample locations shown on Figure 8.1. Samples will be tested for the parameters set in the governing permits.

Process component and process material monitoring will consist of tracking the use of reagents used in the process, and the efficiency of the recovery process in gold recovery and reagent consumption. This monitoring will be conducted according to Gwalia standard operating procedures.

8.3 PROCESS MATERIAL MONITORING

Field tests are planned to further characterize the rinsed, agglomerated ore, and develop final field and laboratory procedures for monitoring and sampling the rinsed agglomerates. Below are the proposed procedures, analyses, and allowable limits of concentration of the residual cyanide in the agglomerates. These procedures and data may be revised pending the results of the field tests. The information listed below is based on a literature review of EPA solid waste criteria, review of operation practices/permit requirement of similar heap leach operations in other states, and test data available to date.



Water, Waste & Land, Inc

Date:	MAR 1989
Project:	190

FIGURE 8.1
MONITORING LOCATIONS

The agglomerates will be rinsed with a pH-modified solution for a period up to fifteen (15) days. During that time, the rinse effluent will be tested for free cyanide using an appropriate analytical procedure. Rinsing will be stopped within the fifteen (15) day period, provided the free cyanide levels measured in the effluent are less than 10 ppm.

Once the rinse cycle has been completed, the material will be removed from the pad and hauled to the disposal area. The leached agglomerates will be sampled as they are removed from the leach pad and tested for residual free cyanide in the solids using the procedures outlined below. Once these procedures have been followed to verify rinsing is complete and that the residual free cyanide in the rinsed agglomerates is reduced to the prescribed levels, the material will be placed in the mine waste disposal area.

At least 40 individual samples (500 g each) will be taken from each pad cell during the unloading period. The samples will be randomly spaced throughout the cell area and identified by cell number, date, time of sample, and the location of the sample. The sample will be returned to the laboratory immediately upon collection and tested as outlined below.

Each sample will be split into two samples--one for immediate testing and one for preservation for future testing. The immediate test sample mass will be 100 ±1 g. The second sample will be preserved and held for sixty days for additional testing.

The test samples will be leached with distilled water in a single pass, flowthrough manner. A predetermined volume of leachate will be collected and alkalized for preservation. The leachate sample is then analyzed via Test Method 412 C or E, detailed in APHA (1985). Test Method 412 D is not appropriate and will not be used.

Based on the test data to date, the following limits of residual free cyanide are recommended for control and monitoring the rinsed agglomerates removed from the pad. The maximum allowable free cyanide shall not exceed the following levels in the filtrate portion of a 5:1 (liquid:solid) extract.

a. 90 percent of consecutive samples collected shall contain less than 5 mg/l free cyanide in the filtrate.

b. None of the samples shall contain more than 10 mg/l free cyanide in the filtrate.

For any sampling location that indicates a free cyanide level in excess of 10 mg/l in the filtrate, the areal extent of the inadequately rinsed area shall be determined and material detoxified so that the cyanide levels in the particular heap area will comply with the limitations presented above.

8.4 REMEDIAL ACTION PLANS

Emergency response or remedial actions will be enacted when the monitoring system detects a variation that has a potential for affecting surface or groundwater at the site. The remedial action shall consist of the following steps:

a. Identification of the source and pathways of migration or escape.

b. Determining an acceptable containment system.

c. Determining methods of remediation.

d. Coordination with DHEC on proceeding with containment and remediation.

9.0 RECLAMATION

9.1 SURFACE GRADING AND RESTORATION

The reclamation planning is designed to stabilize areas disturbed by mining operations and to restore a productive and self-sustaining vegetation cover. The site will be left in a safe condition with protection of natural resources. The proposed land use after completion of mining operations is as a grassland, since this is the most practicable vegetation type that can be re-established. The surface areas affected by the proposed mining operation will be graded or treated to provide a suitable area for reclamation.

The mine pit slopes will be stabilized by dozing or blasting areas, benches, or slopes determined to be unstable. It is not feasible to revegetate the pit slopes and benches, since the rock surfaces are not amenable to topsoiling and seeding. Experience with pits in similar areas has shown that natural revegetation will occur on some of the stabilized areas by hardy, pioneer plant species.

The mine waste disposal and leach pad areas will be graded to provide stable slopes of not greater than 3H:1V, except as noted. Slopes on the surfaces of waste disposal areas and leach pads will not be less than one-quarter percent to provide runoff and prevent ponding. Drainage channels will be re-established to provide for runoff and prevent erosion. Temporary measures used to control erosion and sedimentation in drainages and channels will be hay bale dams or small check dams of rock or soil.

After the remaining solutions in the ponds have evaporated, the pond liner bottom will be deliberately punctured, and the pond liner sides will be pushed into the bottom of the ponds. The ponds will be filled with soils, and the pond surfaces will be mounded to minimize infiltration through the ponds.

Six to eight inches of topsoil will be placed over areas to be reclaimed and seeded with native grass species.

9.2 SOILS STRIPPING AND STOCKPILING

The topsoils and subsoils suitable for use in reclamation will be stripped from all areas of the mine and other areas to be disturbed for waste disposal areas, leach pads, or plant facilities. The depths and areal extent of the soils suitable for stripping will be field determined prior to start of construction.

The soils will be stripped by using appropriate equipment and transported to identified soil stockpile areas (shown on Figure 7.1). The stockpiled soils will be stabilized, then seeded with a quick growing vegetative cover such as annual rye grass.

9.3 SURFACE AND SOIL PREPARATION AND AMENDMENTS

After grading, the surfaces to be reclaimed will be roughened prior to placement of topsoil to ensure a good contact. Areas compacted by heavy machinery in haulage routes, roads, or process sites will be ripped to a maximum depth of two feet to allow for root and water penetration.

The soils on site will be tested for amendment requirements prior to spreading of topsoil. The stockpiled soil will be spread on the graded and prepared surfaces to an average depth of eight inches, and fertilizer and lime will be applied, if necessary. The surface will be disked to work the material into the soil and prepare the seedbed.

9.4 REVEGETATION

The prepared seedbed will be revegetated to a grassland using a seed mix as recommended by the Cooperative Extension Service, Clemson University (Information card No. 91, 1985 Fall Planting Guide; pers. comm., Dr. C.N. Nolan, Extension Agronomist).

This mixture will be drilled at the recommended rate on all areas, except local steep slopes where it will be hand broadcast at double the drilled rate and then raked. The planting will be done in the early fall to provide good germination and growth before winter. The revegetated areas will be top-dressed in late winter to provide for spring growth.

9.4 MAINTENANCE AND MONITORING

To allow for a good stand of vegetation to become established, the revegetated areas will be protected throughout the first and second growing season. The vegetation will be monitored in the spring and all of the first growing season to determine plant germination and growth success. If necessary, remedial measures such as reseeding, additional fertilization, and weed suppression will be employed. At the end of the second growing season, the vegetation will be surveyed to ensure that there is at least a 75 percent ground cover, and no large bare spots exist.

The schedule for performing reclamation will be determined by mining and processing activities. Interim erosion control and stabilization will be done on any areas bared during construction or on features such as topsoil stockpiles, road cuts and fills, and building sites. Final reclamation and stabilization or the project site will commence as soon as the operations cease and be completed no later than the fall after the year of closure.

10.0 REFERENCES

Algermissen, S. T., D. M. Perkins, P. C. Thenhaus, S. L. Hanson, and B. L. Bender, 1982. "Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States," USGS Open-File Report 82-1033.

American Public Health Association (APHA), American Water Works Association, and Water Pollution Control Federation, 1985. "Standard Methods for the Examination of Water and Wastewater," Sixteenth Edition.

Bishop, A. W., 1955. "The Use of the Slip Circle in the Stability Analysis of Slopes," Geotechnique, Vol. 5, pp. 7-17.

Boutrup, E., and R. A. Siegel, 1977. Computerized Slope stability Analysis for Indiana Highways, Purdue University.

Janbu, N., 1973. "Slope Stability Computations," in Embankment-Dam Engineering, R. Hirschfield and S. Poulos, Eds., John Wiley and Sons.

Marsal, R. J., 1973. "Mechanical Properties of Rock-fill," in Embankment-Dam Engineering, R. Hirschfield and S. Poulos, Eds., John Wiley and Sons.

McClelland Laboratories, Inc., 1988. "Report on Heap Leach Cyanidation Testwork - Barite Hill Ore Composites (Environmental Stage)," prepared for BP Minerals American, December 17.

U.S. Army Corps of Engineers, 1985. "HEC-1 Flood Hydrograph Package," Computer Program 723-X6-L2010, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, CA, September.

U.S. Army Corps of Engineers, 1982a. "HEC-2, Water Surface Profiles," Computer Program 723-X6-L202A, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, CA, September.

U.S. Army Corps of Engineers, 1982b. "Engineering and Design Stability for Earth and Rockfill Dams," EM 1110-2-1902.

U.S. Department of Agriculture, 1961. "Rainfall Atlas of the United States; Technical Paper No 40," David M. Hershfield.

U.S. Environmental Protection Agency (EPA), 1985. 40 CFR Part 261, Appendix II - EP Toxicity Test Procedures, U.S. Government Printing Office, July 1.

Wilson, S. D., and R. J. Marsal, 1979. Current Trends in the Design and Construction of Embankment Dams, ASCE.

APPENDIX A

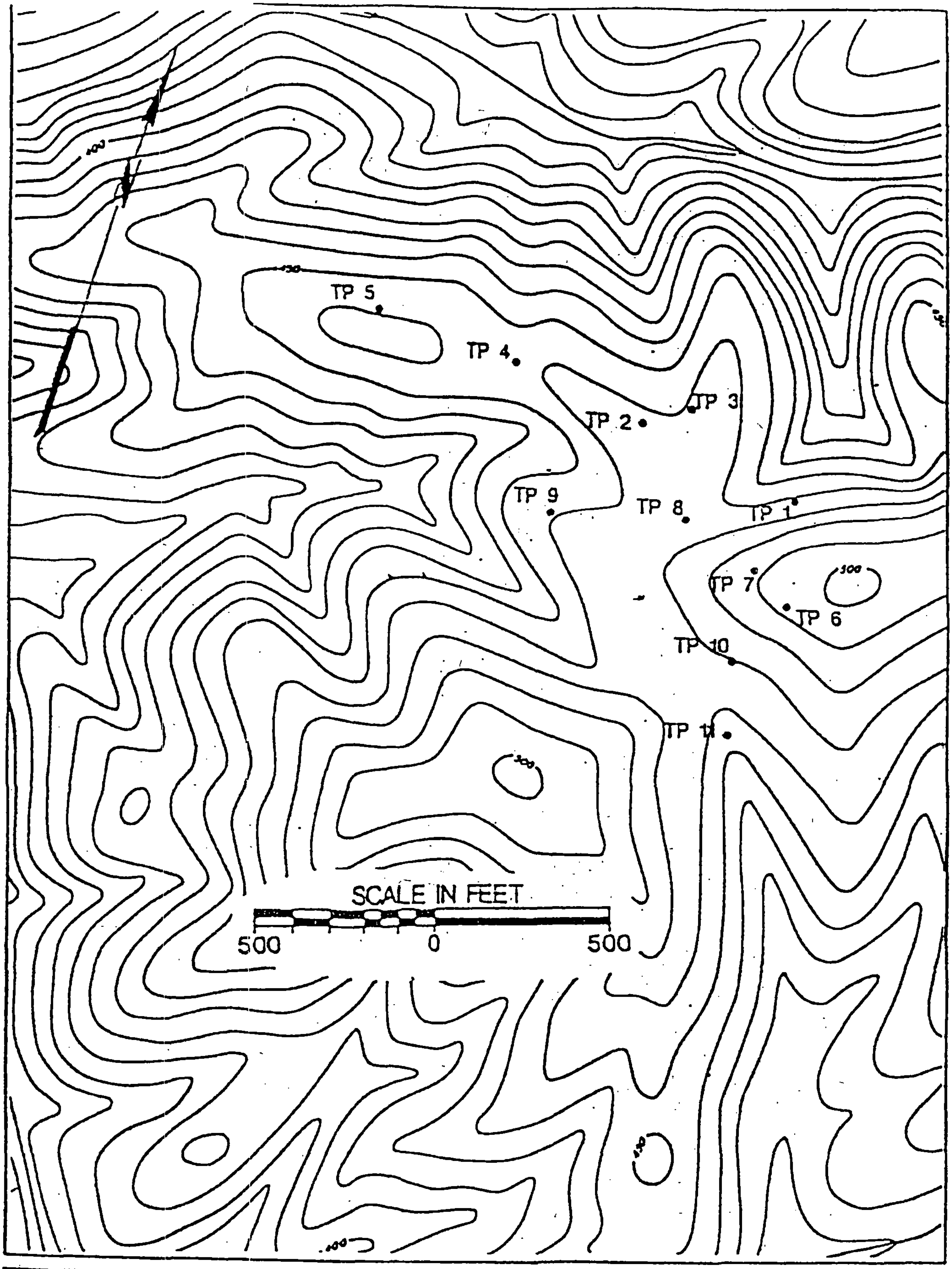
SITE EXPLORATION

A.1. SITE EXPLORATION

The site exploration for the design of heap leach facility consisted of surficial reconnaissance and excavation and logging of 11 backhoe trenches dug on February 2, 1989. Samples of the materials encountered were obtained for laboratory testing. The approximate location of backhoe test pits are shown on Figure A.1.

A.2. FIELD RESULTS

The logs of the backhoe test pits are shown on Figure A.2. The subsoil conditions at the site generally consist of approximately one foot of topsoil. Under the topsoil, approximately two to four feet of red clayey, gravelly, high plastic silt exists. Beneath the red silt, one to three feet of a yellow clayey, gravelly, low plastic silt was encountered. Beneath the yellow silt material bedrock was encountered. The depth to bedrock varied from two to eight feet. The bedrock varied from a claystone/siltstone to a metamorphic rock. The metamorphic rock was very hard and could not be excavated with the backhoe.



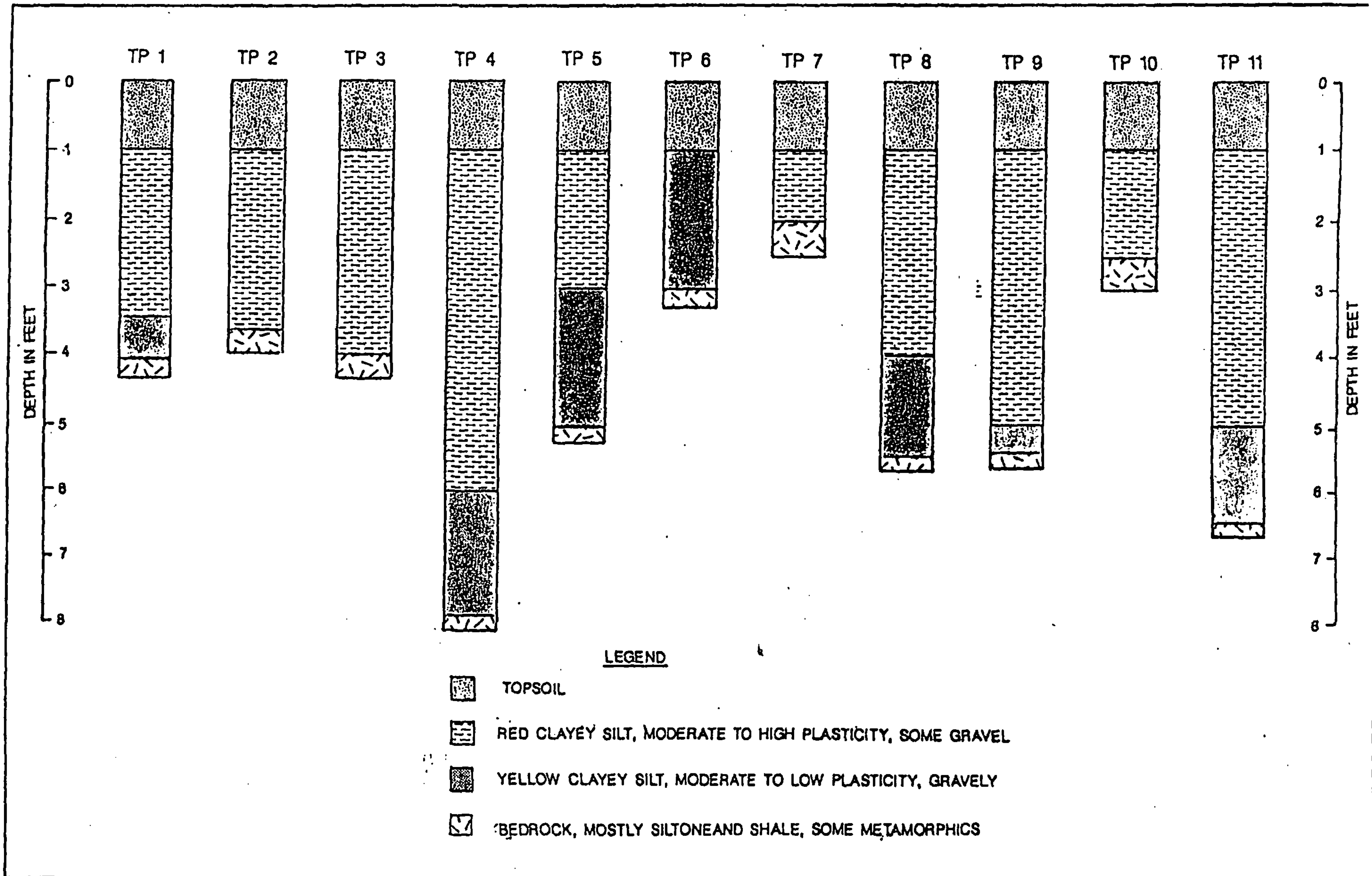
Water, Waste & Land, Inc.

FIGURE A.1

BACKHOE TEST PIT LOCATIONS

Date: MARCH 1989

Project: 190



Water, Waste & Land, Inc.

FIGURE A.2
LOGS OF BACKHOE TEST PITS

Date: MAR 1989

Project: 190

APPENDIX B

LABORATORY TESTING

B.1 DESCRIPTION OF SAMPLES

Selected samples obtained from the site investigation program were tested for physical parameters. As indicated in Appendix A, there are two soil types overlying the bedrock: red clayey, high plastic silt anddyellow clayey, low plastic silt. Representative samples of both the red silt and yellow silt were selected for testing.

B.2 INDEX TESTS

In general the red clayey silt has 70 to 90 percent passing the #200 sieve. The material classifies as a ML according to the Unified Soil Classification System (USCS). The yellow clayey silt has 50 to 90 percent passing the #200 sieve, and varying amounts of gravel-sized particles. The USCS classification for this material is SM to ML. Table B.1 presents a summary of the index test results.

Visual identification was used to combine the material into two composites: red clayey silt and yellow clayey silt. The index testing for the composited samples are shown in Table B.1. The grain size curves for the composite samples are shown on Figures B.1 and B.2.

B.3 MODIFIED PROCTOR TEST

Modified Proctor tests were performed on the two composite samples. The red silt material has a maximum dry density of 108 pcf and an optimum moisture content of 17 percent. The yellow silt has a maximum dry density of 113 pcf and an optimum moisture content of 14 percent. Figures B.3 and B.4 present the Proctor test results.

B.4 PERMEABILITY TESTS

A falling head permeability test was conducted on each of the composite samples. The samples were remolded to 95 percent of Modified Proctor density. The test results are shown on Figure B.5 and B.6. The saturated hydraulic conductivity (or permeability) for the red clayey silt composite was 1x10-7 cm/sec, and 7x10-7 cm/sec for the yellow clayey silt composite.

Permeability test samples were back-pressure saturated, then tested by the falling head test, with the maximum head on the sample being approximately 8 ft.

B.5 HVEEM STABLEOMETER TESTS

The 'R' value was determined for both of the composite samples using the Hveem stableometer. The 'R' value for the samples are given on Figures B.7 and B.8.

TABLE B.1

SUMMARY OF INDEX TEST RESULTS

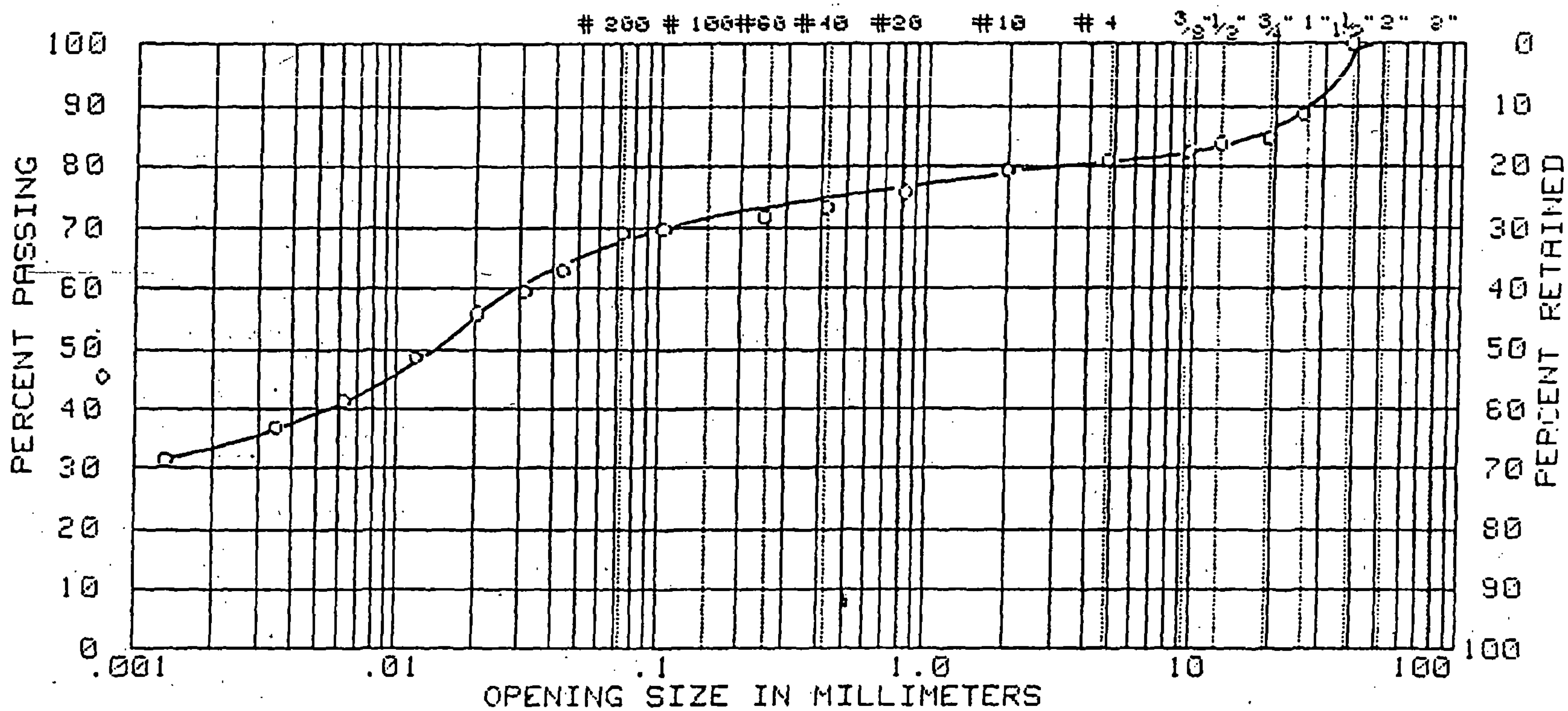
Trench	Depth	Material	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve	Classification Unified	Classification AASHTO
1	3.0	YC	33.3	29.0	4.3	49.0	SM	A-4(0)
3	2.0	RC	42.2	23.5	18.7	92.0	CL	A-7-6(19)
5	4.0	YC	27.7	25.2	2.5	62.1	ML	A-4(0)
6	3.0	YC	31.3	29.7	1.6	82.0	ML	A-4(2)
8	5.0	YC	44.8	37.4	7.4	68.2	ML	A-5(6)
9	5.5	YC	40.5	33.5	7.0	94.3	ML	A-5(10)
10	3.0	RC	48.1	32.3	15.8	77.3	ML	A-7-5(14)
11	6.0	YC	32.4	29.0	3.4	52.0	ML	A-4(0)
RC Composite		RC	52.0	34.1	17.9	68.2	MH	----
YC Composite		YC	30.6	28.6	2.0	79.7	ML	----

RC - red clayey silt
YC - yellow clayey silt

EMPIRE LABORATORIES INC.

GRAIN SIZE DISTRIBUTION CURVE

PROJECT: WATER, WASTE AND LAND PROJECT #190
LOCATION OF SAMPLE: BARITE MINE SITE RED CLAYEY SILT COMPOSITE
AASHTO: A-7-5(13)
USCS: MH OR OH



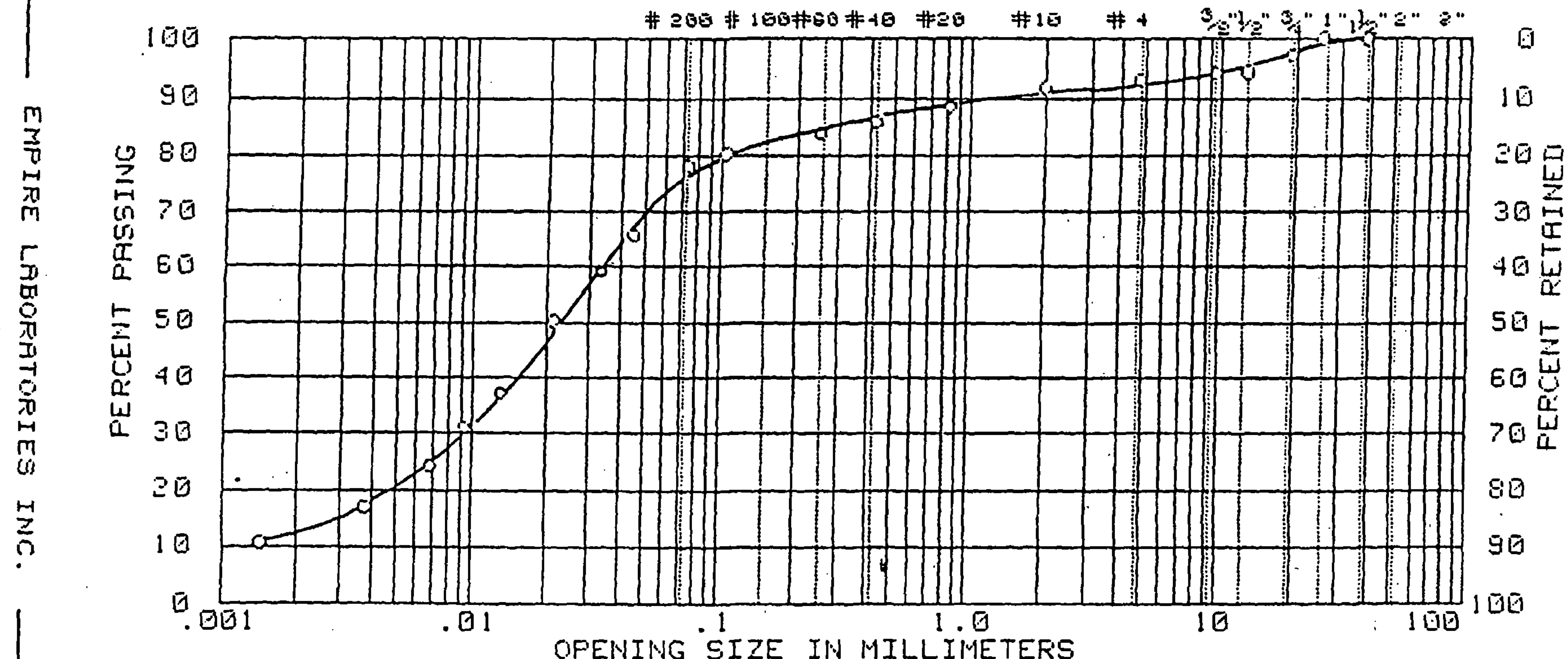
% CLAY	% SILT	% SAND			% GRAVEL
		FINE	MEDIUM	COARSE	
38.8	30.2	4.2	6.1	1.6	19.2

LIQUID LIMIT= 52.0 PLASTICITY INDEX= 17.9

FIGURE B.1

GRAIN SIZE DISTRIBUTION CURVE

PROJECT: WATER, WASTE AND LAND PROJECT #190
LOCATION OF SAMPLE: BARITE MINE SITE YELLOW CLAYEY SILT COMPOSITE
AASHTO: A-4(2)
USCS: ML OR OL



% CLAY	% SILT	% SAND			% GRAVEL
		FINE	MEDIUM	COARSE	
19.0	59.1	7.6	5.9	1.4	6.9

LIQUID LIMIT= 30.6 PLASTICITY INDEX= 2.0

FIGURE B.2

MOISTURE DENSITY CURVE

CURVE # 1

PROJECT: WATER WASTE & LAND - #190

LOCATION OF SAMPLE: BARITE MINE SITE -
RED CLAYEY SILT COMPOSITE

SAMPLE DESCRIPTION: RED-BRN SANDY SILTY CLAY
& SILTSTONE-CLAYSTONE W/TR. GRAVEL

TEST PROCEDURE: ASTM D 1557-78 Method C

MAXIMUM DRY DENSITY: 108.3 PCF

OPTIMUM MOISTURE: 16.8 %

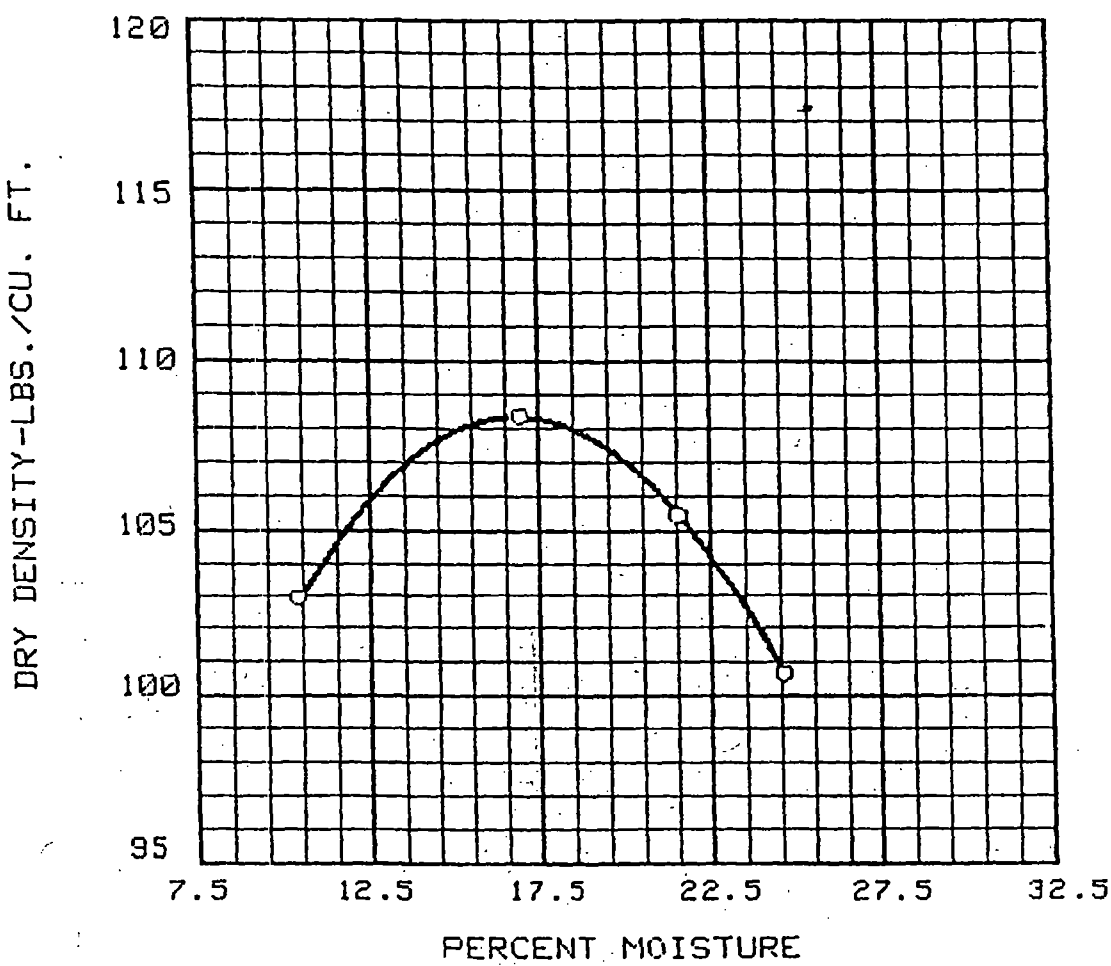


FIGURE B.3

EMPIRE LABORATORIES INC.

MOISTURE DENSITY CURVE

CURVE # 2

PROJECT: WATER, WASTE AND LAND PROJECT #190

LOCATION OF SAMPLE: BARITE MINE SITE

YELLOW CLAYEY SILT COMPOSITE

SAMPLE DESCRIPTION: ORANGE-BROWN SILTSTONE

TEST PROCEDURE: ASTM D 1557-78 Method C

MAXIMUM DRY DENSITY: 112.9 PCF

OPTIMUM MOISTURE: 13.8 %

LL: 30.6 PI: 2.0 %-200: 79.7

USCS CLASS: ML OR OL AASHTO CLASS: A-4(2)

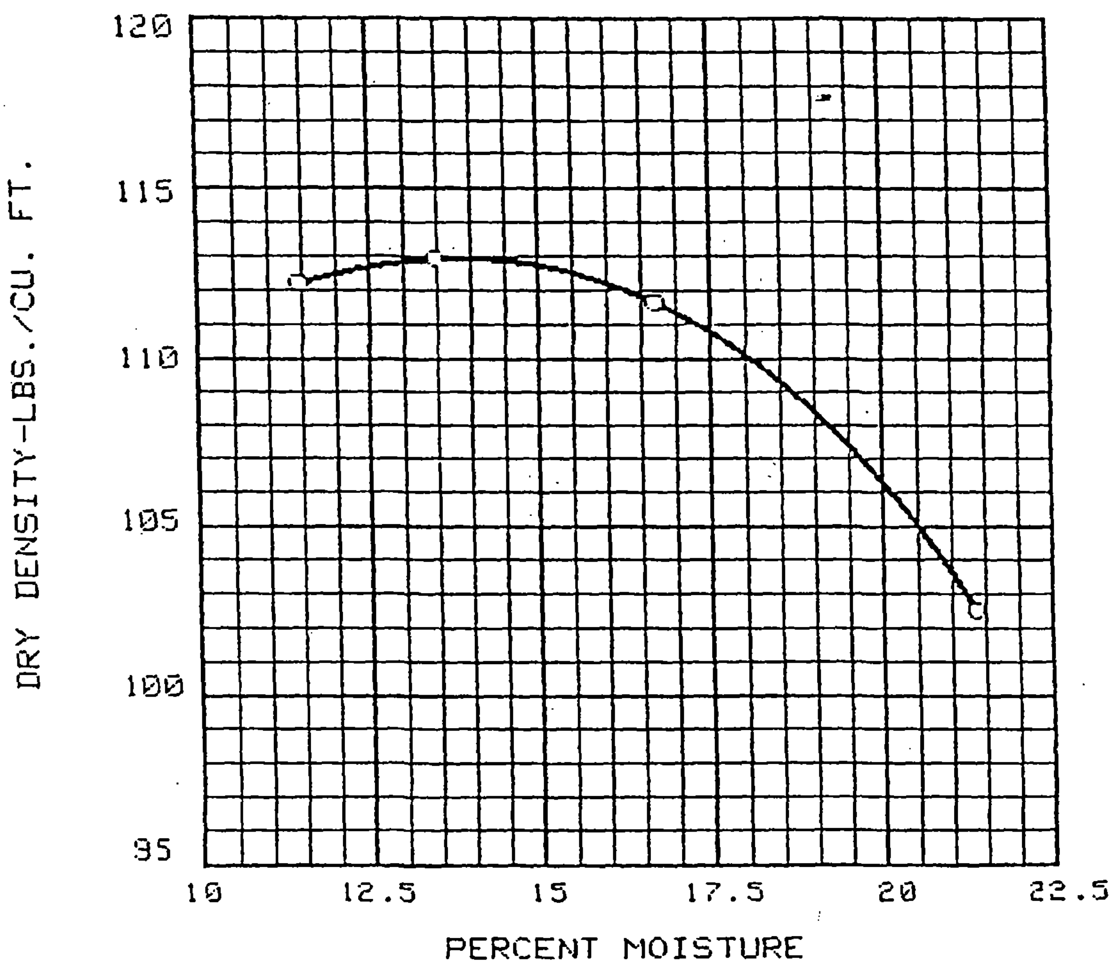


FIGURE B.4

EMPIRE LABORATORIES INC.

PERMEABILITY

PROJECT: WATER WASTE & LAND, INC.
#190 BARITE MINE SITE -
RED CLAYEY SILT COMPOSITE

SAMPLE NUMBER:

TEST PROCEDURE: FALLING HEAD METHOD

DENSITY: 103.2 PCF @ 95.3% MODIFIED PROCTOR

PERMEABILITY: .19 FT/YR = .18 X 10^{-6} CM/SEC

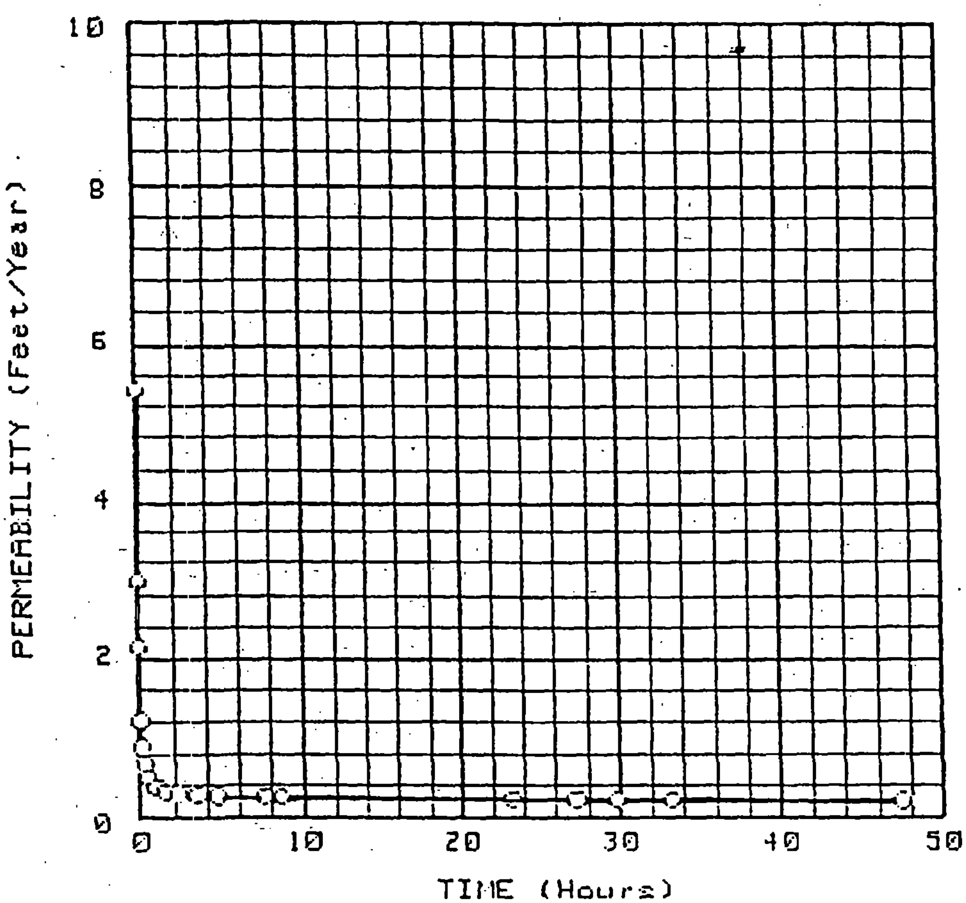


FIGURE B.5

EMPIRE LABORATORIES INC.

PERMEABILITY

PROJECT: WATER WASTE & LAND, INC.
#190 BARITE MINE SITE -
YELLOW CLAYEY SILT COMPOSITE

SAMPLE NUMBER:

TEST PROCEDURE: FALLING HEAD METHOD

DENSITY: 107.8 PCF @ 95.5% MODIFIED PROCTOR

PERMEABILITY: .70 FT/YR = .68 X 10^{-6} CM/SEC

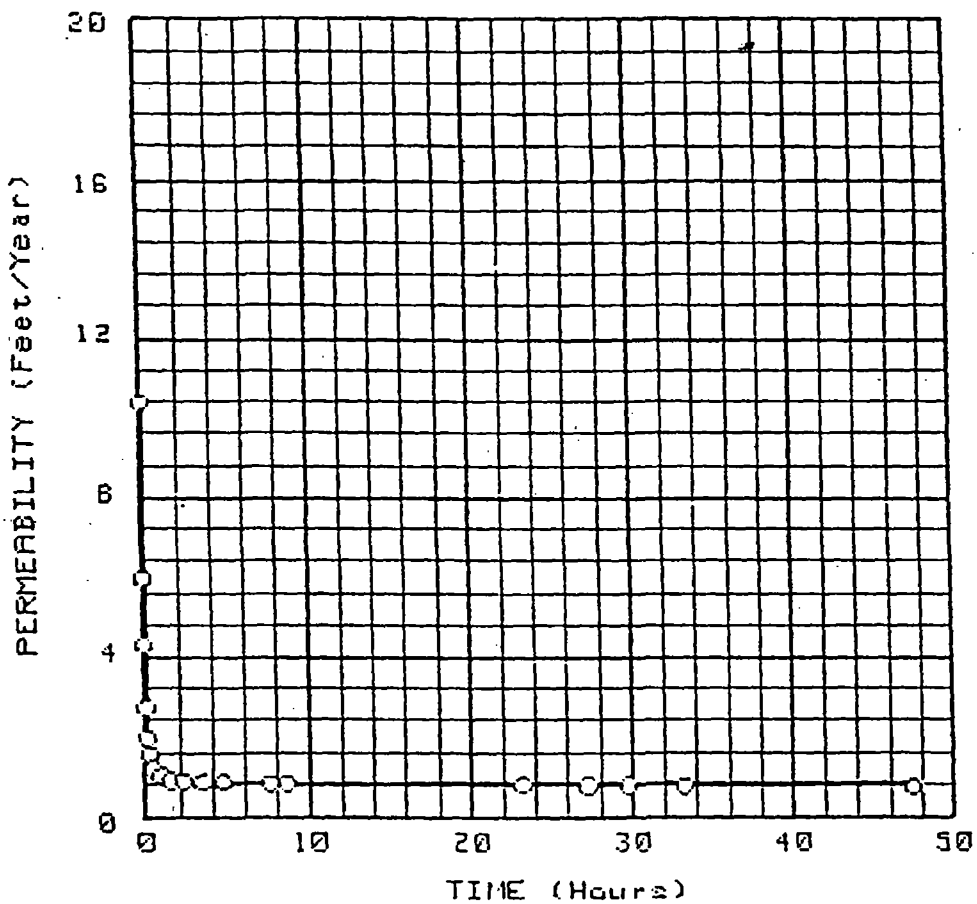


FIGURE B.6

EMPIRE LABORATORIES INC.

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOIL

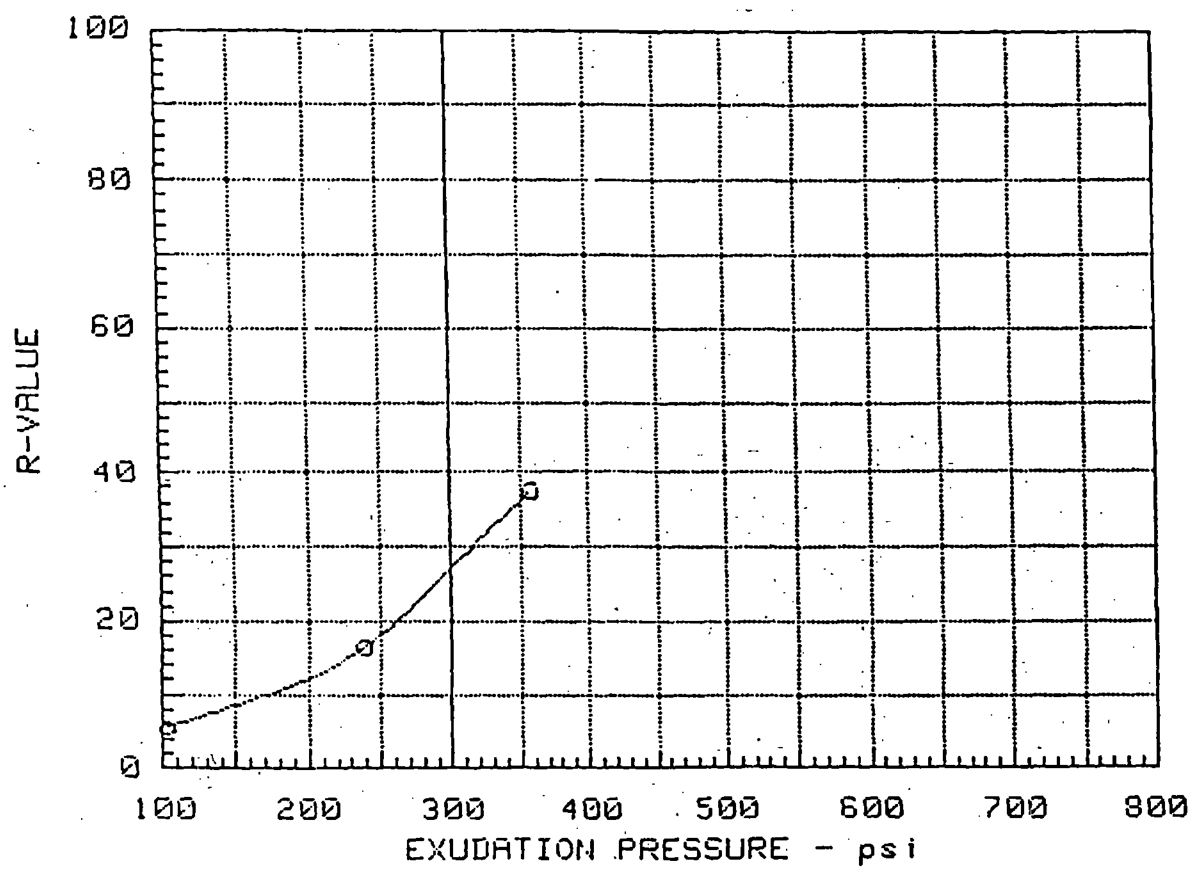
ASTM - D 2844

CLIENT: WATER WASTE & LAND
PROJECT: # 190 BARITE MINE SITE
LOCATION OF SAMPLE: RED CLAYEY SILT COMPOSITE

SAMPLE DATA

TEST SPECIMEN	1	2	3
COMPACTION PRESSURE - PSI	60	280	350
DENSITY - PCF	91.4	97.4	104.1
MOISTURE - %	31.1	26.6	21.6
EXPANSION PRESSURE - PSI	0.00	0.09	1.33
HORIZONTAL PRESSURE @ 160 psi	148	126	89
SAMPLE HEIGHT - in.	2.57	2.53	2.53
EXUDATION PRESSURE - PSI	103	239	358
UNCORRECTED R-VALUE	5.4	16.5	37.6
CORRECTED R-VALUE	5.5	16.5	37.6

R-VALUE AT 300 PSI EXUDATION PRESSURE = 27.2



EMPIRE LABORATORIES INC.

FIGURE B.7

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOIL

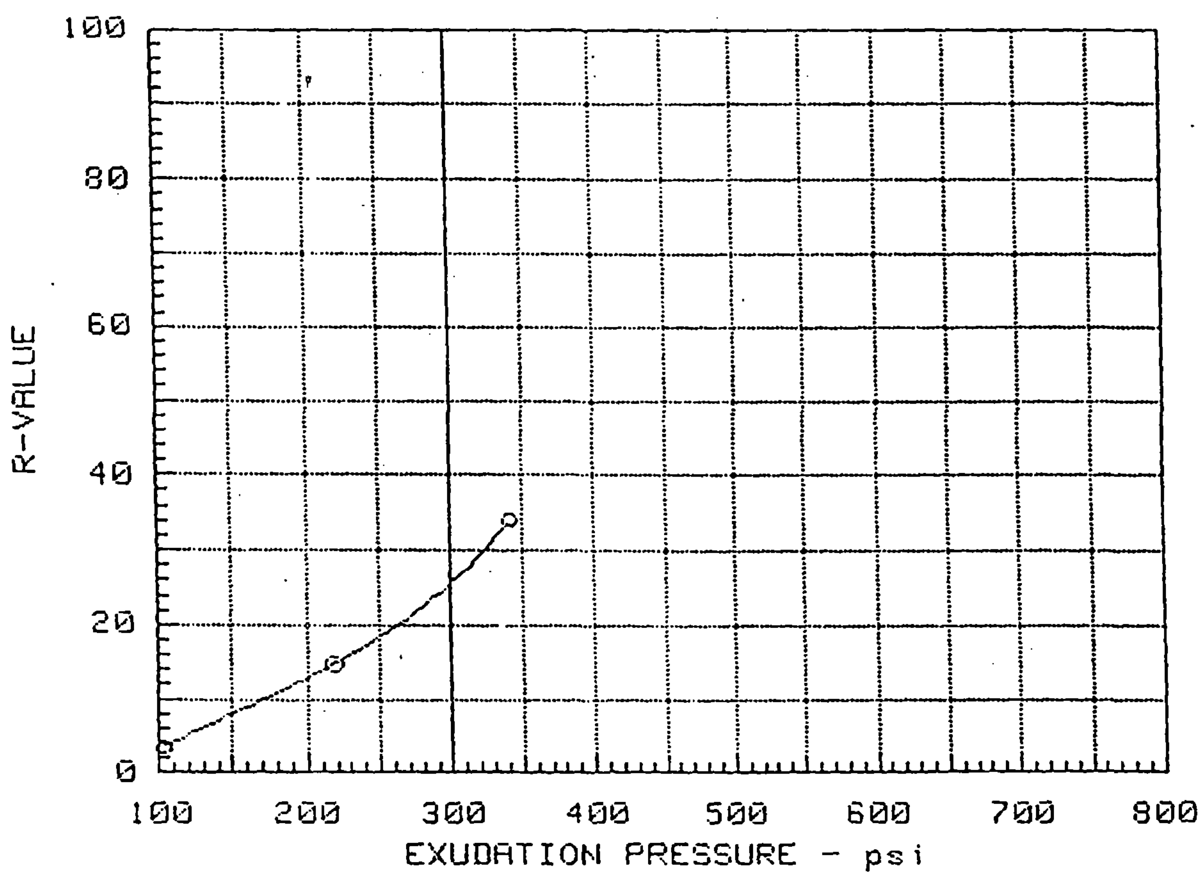
ASTM – D 2844

CLIENT: WATER WASTE & LAND
PROJECT: # 190 BARITE MINE SITE
LOCATION OF SAMPLE: YELLOW CLAYEY SILT COMPOSITE

SAMPLE DATA

TEST SPECIMEN	1	2	3
COMPACTION PRESSURE - PSI	140	280	350
DENSITY - PCF	104.4	111.8	112.7
MOISTURE - %	21.0	18.2	16.5
EXPANSION PRESSURE - PSI	0.00	0.00	1.85
HORIZONTAL PRESSURE @ 160 psi	150	124	78
SAMPLE HEIGHT - in.	2.46	2.55	2.41
EXUDATION PRESSURE - PSI	103	219	342
UNCORRECTED R-VALUE	3.6	14.5	36.2
CORRECTED R-VALUE	3.6	14.9	34.2

R-VALUE AT 300 PSI EXUDATION PRESSURE = 25.7



EMPIRE LABORATORIES INC.

FIGURE B.8

APPENDIX C

DESIGN ANALYSES

TABLE OF CONTENTS

C.1 WATER BALANCE

C.1.1 Climate Data

The precipitation and evaporation data used in the water balance calculations was obtained from USGS data. The Clark Hill Dam station was chosen for both its close proximity to the Barite mine (approximately three miles to the west), and the amount of supporting climate data. The McCormick station was also reviewed but is located a farther distance from the mine site than Clark Hill Dam and the data was not as complete. The climate data used for the water balance is summarized below.

MONTH	WET YEAR PRECIP (inches)	AVG YEAR EVAP (inches)
JAN	9.68	0.00
FEB	5.20	2.11
MAR	8.47	3.76
APR	5.74	5.22
MAY	4.49	5.94
JUN	4.99	7.30
JUL	8.66	6.90
AUG	11.08	5.79
SEP	1.06	4.16
OCT	8.45	3.42
NOV	2.29	1.92
DEC	6.17	0.00

C.1.2 Discussion of Results

The water balance requirements were based upon conservative conditions of: 1) the wettest year on record (USGS data from 1952); 2) 2 to 4 percent spray evaporation loss from heap leaching; and 3) 8 percent moisture loss to wet and agglomerate the ore. Other less conservative spray evaporation and moisture loss values were used in the calculation. It was apparent from various trials that the water balance was most sensitive to the ore moisture loss and spray evaporation.

Evaporation from the ponds was calculated using the water balance information presented above. The additional evaporation due to the sprinkling of the solution over the heaps was assumed to be 2 percent of the total process flow during the winter months and 4 percent of the process flow during the summer months. These evaporation rates are a conservative representation of rates experienced on similar projects. Leachability test data indicated the in-place moisture content of the ore is approximately 3 to 5 percent and the water retained in the washed leached agglomerate (including the water used for agglomeration) is approximately 12 to 15 percent.

A water balance was performed by summing, on a monthly basis, the water inputs (precipitation, make-up water and the moisture content of the ore) and outputs (evaporation and the moisture content of the spent ore when it is removed from the pad) to determine the net gain (or loss) of water expected under normal conditions. Make-up water was only added to maintain a minimum volume of water in the ponds for process considerations. The final calculations showed a balance of 3 acre ft for storage requirements.

C.2 POND SIZING

Since the process is designed as a closed-loop circuit (or closed system), the ponds must be able to contain all of the water expected during the operation of the facility. This volume of water would include net accumulation (or loss) of water caused by normal precipitation and evaporation, the water from the design precipitation event (100-year, 24-hour event) and the water in the system necessary for process requirements.

The total precipitation from the 100-year, 24-hour event was determined to be 8 inches, from USDA (1961). The volume of water assumed necessary for operation was assumed to be 500,000 gallons (the process rate of 350 gpm for 24 hours). In addition, a volume of water that would drain from the ore was included in the pond sizing calculations. This volume was calculated to be 250,000 gallons (the process flow rate of 350 gpm for 12 hours).

A summary of the pond sizing analysis is presented on the next page.

SIZING CRITERIA	VOLUME (acre-ft)	(million gal)
100-YR, 24-HR EVENT (8 in. x process/pond area)	3.0	1.00
OPERATING VOLUME (350 gpm x 24 hrs)	1.5	0.50
DRAINDOWN VOLUME (350 gpm x 12 hrs)	0.8	0.25
WATER BALANCE REQUIREMENT (Maximum accumulation during the life of the project)	3.0	1.00
TOTALS	8.3	2.75

The pregnant solution pond was designed to contain approximately 50 percent of the volume with the other two ponds containing 25 percent each. A fourth pond (carbon pond) is located near the plant and is used for operation purposes and was not included in the water balance calculations. The pond sumps (depth of 3 ft) were not included in the sizing calculations. In addition, 2 ft of freeboard was added when the ponds were sized. The calculated pond top dimensions and depths are outlined below:

Pregnant pond:	180 x 180 x 12 ft
Barren pond:	130 x 130 x 12 ft
Wash Water pond:	130 x 130 x 12 ft
Carbon pond:	50 x 50 x 4 ft

The depths of the pregnant solution, barren, and wash water ponds do not include the sump. The depths to the bottom of the sumps are approximately 15 ft. A sump was not provided for the carbon pond.

C.3 WASTE DISPOSAL AREA DESIGN

C.3.1 Design Quantities

Mine waste disposal areas were sized for 3.9 million tons of material (1.5 million tons of leached agglomerates and 2.4 million tons of mine waste, at a stripping ratio of 1.6:1). Based on the geochemical data available to date, the waste rock and leached agglomerates do not need to be kept separate. Assuming an average dump material unit weight of 120 pcf, the required capacity totals 65 million cubic ft (1492 acre-ft or 2.4 million cubic yds). Based on available land, three waste disposal areas were identified, as shown on Figure 7.1.

C.3.2 Site Capacities

Site A is a valley site immediately southwest of the leaching/processing area, with a capacity of 0.87 million tons. Site B is a valley site immediately east of the Main Pit, with a capacity of 1.00 million tons. Site C is a side hill site southeast of the leaching/processing area, with a capacity of 1.73 million tons. In addition, the Rainsford Pit has an available capacity of 0.30 million tons. The total available and required capacities for the waste disposal areas are summarized below.

SITE	TOP ELEV (ft)	MATERIAL SOURCE	MATERIAL QUANTITY[a] (million tons)	DESIGN CAPACITY (million tons)
A	450	Rainsford Pit + Leached Agglomerates	0.30 + 0.57	0.87
B	460	Main Pit	1.00	1.00
C	490	Main Pit + Leached Agglomerates	1.10 + 0.63	1.73
D	490	Leached Agglomerates	0.30	0.30
		TOTALS	3.90	3.90

[a]Material quantities:
- Leached agglomerates - 1.5 million tons
- Main Pit waste - 2.1 million tons
- Rainsford Pit waste - 0.3 million tons

As listed above, the disposal plan is to use Waste Disposal Area B for Main Pit waste rock, Site A for Rainsford Pit waste rock and leached agglomerate, the mined-out Rainsford Pit for leached agglomerate, and Site C for leached agglomerate and waste rock from the Main Pit.

Leached agglomerate dumped in the mined-out Rainsford Pit is planned in order to have some high pH material covering the exposed sulfide material in the pit.

C.3.3 Dump Construction

One of the first components of waste disposal area to be constructed will be the lower benches (depending on material availability). These benches will be constructed of coarse durable waste rock to maintain a low phreatic surface and to aid in the drainage of the area.

In addition to coarse material being placed at the toe of the waste disposal area to form the lower bench, coarse durable waste rock will also be used to fill the lower portion of the bottom of the existing gullies. This coarse material will facilitate rapid drainage of the waste disposal areas. Except for the two areas discussed above, the waste will not be segregated, sorted, or otherwise kept separate.

Waste disposal area slopes will be trimmed to 3:1 for reclamation, with minimum 50-ft wide benches on 10-ft minimum elevation intervals. Runoff from natural areas above the waste disposal areas will be diverted from the areas as much as possible.

C.3.4 Runoff Control

Each of the three waste disposal areas will drain to the lowest bench at the downstream toe of each area. Each of these benches will have a berm to temporarily retain storm runoff. The height of the berms and the area of the lower benches were designed to contain all of the runoff from a 100-yr, 24-hr event. The volume of water for which the retention benches were designed are the berm heights are summarized below:

SITE	CATCHMENT AREA (acres)	STORAGE CAPACITY (acre ft)	BERM HEIGHT (ft)
A	20.2	10.0	7
B	49.1	20.2	6
C	41.6	15.6	10

C.3.4 Infiltration

As stated previously, the retention structures were sized for the 100-yr, 24-hr event. Estimates of the length of time of the retention ponds to drain through the bottom of the mine waste were performed, assuming they were filled instantaneously to the top of the retention berm. The Green-Ampt infiltration equation was used for the calculations (McWhorter and Nelson, 1978). The calculations were made assuming no low-permeability materials on the retention structures.

The results of these calculations (represented by the time to drain and penetration depths) for each site are listed below.

SITE	POND DEPTH (ft)	DRAINAGE TIME (days)	PENETRATION DEPTH (ft)
A	7	1.41	30
B	6	1.18	35
C	10	2.08	50

These results indicate relatively short drainage times, and are based on a conservative waste rock permeability of 10^{-3} cm/sec. The coarse, durable waste rock is likely to be more permeable.

C.4 DIVERSION CHANNEL DESIGN

Three diversion channels will be constructed to divert or direct flow from undisturbed areas away from the leach pad and waste disposal areas. These channels were sized for the peak runoff from the 100-yr event.

Peak runoff was estimated in the major catchments in the site area under current conditions (prior to mining activities). The major catchments are shown on Figure 5.1, along with the diversion channels.

Peak runoff was evaluated with the HEC-1 program (U.S. Army Corps of Engineers, 1985), using assumed parameters listed in the table below. Curve numbers used in the evaluation were based on Antecedent Moisture Condition II and soil groups representative of the soils in the site area. Peak flows from the 100-yr event are presented below.

WASTE DISPOSAL AREA	WATERSHED	AREA (sq ft)	AREA (sq mi)	AVERAGE LENGTH (ft)	SLOPE (%)	CN	LAG-TIME (hr)	PEAK FLOW (cfs)
A	1	427,300	0.0153	800	10.2	77	0.09	77
	2	308,650	0.0111	850	13.3	77	0.08	116
B	1	255,425	0.0092	400	9.0	77	0.06	49
	2	397,075	0.0142	400	4.7	77	0.08	109
	3	435,438	0.0156	1400	3.3	77	0.25	58
	4	202,388	0.0073	1250	3.3	77	0.23	81

Velocities and depths of flow at selected ditch cross sections were calculated with the HEC-2 program (U.S. Army Corps of Engineers, 1982a).

The analyses show the south diversion channel from Site A would have a peak discharge of 116 cfs. The channel will have a bed slope of 0.25 percent. The peak velocities range from 2.0 to 2.8 ft/sec with the maximum depth of flow ranging from 2.0 to 2.5 ft.

The analyses show that the west diversion channel from Site B would have a peak discharge of 109 cfs. The channel will have a bed slope of approximately 0.25 percent. The peak velocities range from 2.0 to 5.4 ft/sec with the maximum depth of flow ranging from 1.1 to 2.0 ft.

The analyses for the east diversion channel from Site B indicated that the peak discharge would be 81 cfs, with peak velocities in the range of 1.6 to 2.7 ft/sec. The slope of the channel will be 0.25 percent. The maximum depth of flow ranges from 1.6 to 2.5 ft.

Given the depths of flow above, all channels will have the same cross-sectional geometry. The ditches will be trapezoidal in section with a bottom width of 10 ft, 3H:1V side slopes and a depth of 3 ft.

C.5 TRANSPORT CHANNEL DESIGN

An asphalt lined channel will exist around the perimeter of the leach pad. This channel will convey the process solution from the leach pad to the pregnant solution pond. In addition to being able to transport the process flow, the channel must be large enough to convey the peak runoff from the 100-yr event. The process flow will be approximately 350 gpm (0.7 cfs). The HEC-1 analysis indicates the peak flow during the design storm will be 40 cfs, conservatively based on the entire pad being free of ore.

Because of the asphalt paving equipment, the channel will have both bottom and sides are 10 ft in slope length. The side slopes will be 3H:1V. Given this configuration, the transport channels will have a total depth of approximately 3.2 ft. HEC-2 analyses of the channel under a total peak flow of 40 cfs indicates the maximum depth in the channel will be 0.8 feet. Because of the small depth of flow, especially during normal operating conditions, the bottom of the channel will be sloped away from the pad at a slope of approximately 2 percent to concentrate flow.

C.6 STABILITY ANALYSIS

C.6.1 General

The mine pits will be excavated with overall slopes as steep as 45 degrees (1:1), with 10 ft high benches. Since the pits should be dry (in the zones that will be mined) and the primary rock types generally of high shear strength, this overall slope should be adequate. The major factor affecting pit slope stability will be joints, faults, perched groundwater, and other features that will not be found until mining is initiated. Pit slopes and benches will be modified as mining proceeds, depending on the conditions that are observed. Stability analyses of the pit slopes were therefore not made.

Heap stability was not evaluated, due to the high frictional resistance between the asphalt leach pad and the ore, and the relatively flat leach pad slopes (slightly steeper than 4 percent).

The waste disposal areas will be constructed of run-of-mine waste rock and leached agglomerates by end dumping in lifts. The underlying rocks beneath the disposal areas are of relatively high shear strength. However, materials of low shear strength may exist between the waste disposal areas and underlying rock. For this reason, stability analyses of critical areas of the mine waste disposal areas were evaluated.

The waste disposal areas most critical for stability were analyzed. These areas were Waste Disposal Sites C, due to waste height and ground slope, and the fact that these sites will contain the most waste rock. Stability was analyzed by evaluating two-dimensional sections through the waste disposal area that would be the most critical for stability. The conditions that were analyzed were the final configuration at the toe of the waste disposal area, and also at the second terrace.

C.6.2 Method of Analysis

Stability was analyzed for moment equilibrium along circular failure surfaces by using a computerized application of the Modified Bishop method (Bishop, 1955). Although the technique does not accommodate noncircular failure surfaces, the Modified Bishop method was used because it is a widely accepted technique, and generally produces lower factors of safety than other techniques.

Stability was also analyzed for force equilibrium along noncircular failure surfaces by using a computerized application of the Janbu method (Janbu, 1973). Due to the configuration of the heap and leach pad, noncircular failure surfaces are likely.

The STABL2 computer program (Boutrup and Siegel, 1977) was used, which employs a random failure surface generation technique. A minimum of 200 trial surfaces was compared with the minimum criteria for factor of safety.

Stability was analyzed for both static and seismic conditions. Seismic conditions were represented in pseudostatic analyses by an equivalent horizontal acceleration or seismic coefficient of 0.05 g. The selection of the seismic coefficient was based on review of published seismicity data (Section 2.9).

C.6.3 Material Properties

Material properties used in the stability analyses were based on shear strength data for similar materials documented in geotechnical and mining literature (such as Marsal, 1973; Wilson and Marsal, 1979). The material properties used in the evaluation are summarized below.

Material	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Shear Strength	
			Cohesion (psf)	Friction Angle (degrees)
Waste Rock	120	120	0	32
Underlying Silty Clay	100	120	0	20
Bedrock	140	140	0	50

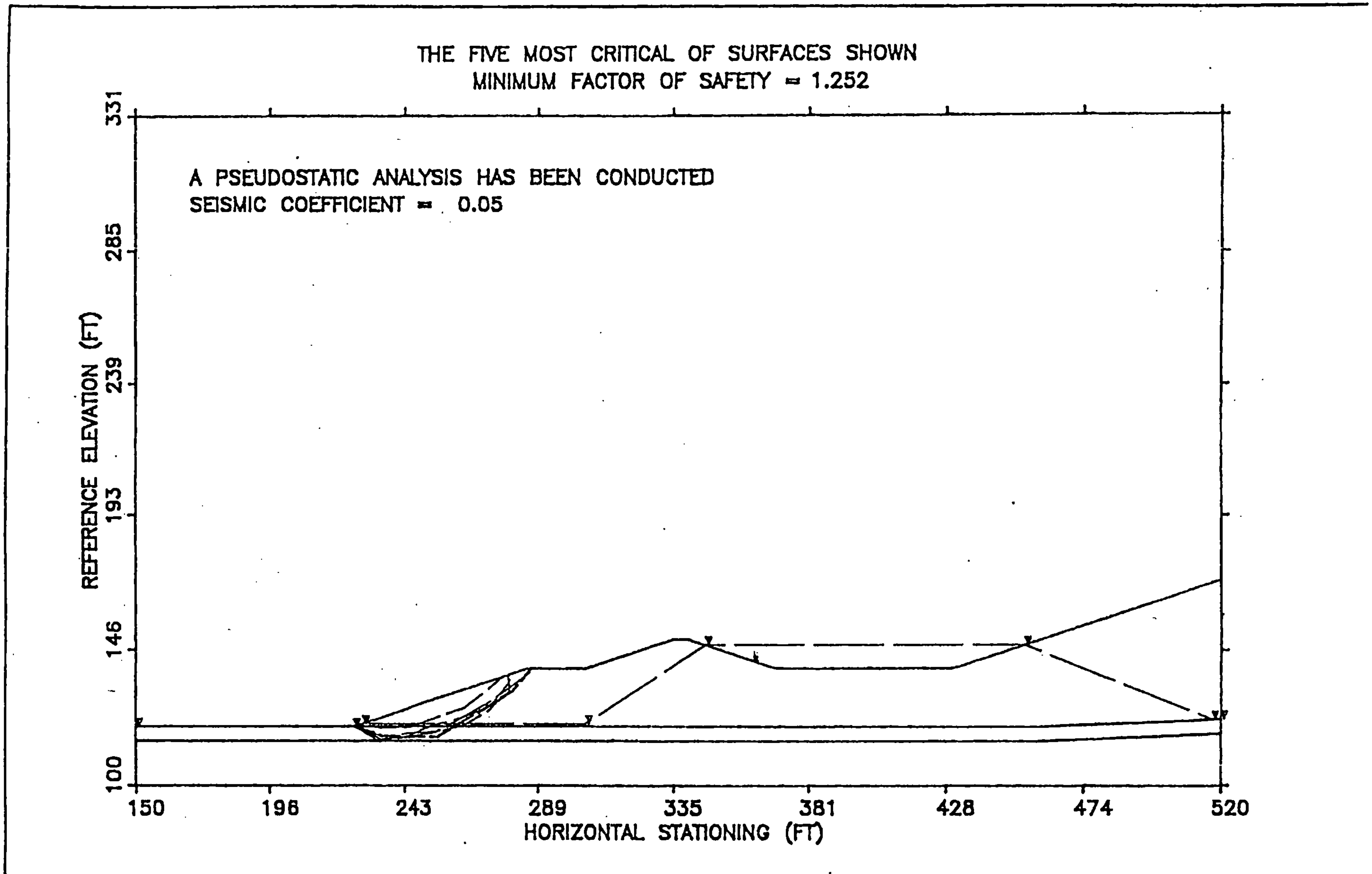
It was conservatively assumed that the phreatic surface existed one ft above the top of the underlying silty clay except in the area beneath the lower bench. In that area, the phreatic surface was assumed to be the top of the pond. This is shown on Figure C.1.

C.6.4 Analysis Results

The slope stability calculations indicated that the toe of the waste disposal area was the more critical area for stability. The factors of safety at the toe were 1.5 and 1.25 for static and pseudostatic conditions, respectively.

These calculated factors of safety are equal to or higher than the accepted minimum values of 1.5 for static conditions and 1.1 for pseudostatic conditions.

Based on the stability analyses outlined above, the mine waste disposal sites should be stable in its designed configuration (with the 3H:1V slopes and 50-ft wide benches), under both static and seismic conditions. Waste Disposal Sites B and C were selected for analysis as being the most critical sites and disposal design for stability. This implies that the other disposal sites (as currently designed) should be stable under both static and pseudostatic conditions, assuming the same strength parameters and phreatic surface conditions as those that were analyzed. Figure C.1 shows the critical failure surfaces and the factor of safety for the pseudostatic condition.



Water, Waste & Land, Inc.

FIGURE C.1
GEOMETRY AND CRITICAL FAILURE SURFACES
FOR PSEUDOSTATIC CONDITIONS

Date: MARCH 1989

Project: 190

APPENDIX D

CONSTRUCTION SPECIFICATIONS

TABLE OF CONTENTS

CONSTRUCTION DRAWINGS

1.0 SPECIAL PROVISIONS

1.1 GENERAL

The technical specifications and construction drawings provided herein comprise the Specifications for construction of the leach pad, mine waste disposal areas, and related facilities at Gwalia (USA) Ltd. (Gwalia) Barite Hill Project. The Specifications form part of the overall contract for construction of the facilities listed above, with the work conducted by a Contractor retained by Gwalia.

1.2 SITE DESCRIPTION AND CONDITIONS

The Barite Hill Project site is in McCormick County South Carolina, approximately 3 miles south of McCormick. The site is on eastern edge of Savannah River Valley at approximately 500 feet elevation.

1.3 SCOPE OF WORK

The work outlined in the Specifications consists of constructing facilities including, but not limited to:

a. Leach pad, with associated collection and leak detection systems;

b. Collection ponds, with associated leak detection systems; and

c. Mine waste disposal areas.

1.4 APPLICABLE CODES AND REGULATIONS

The work shall conform to applicable Federal, State, and County regulations. Test procedures shall conform to applicable ASTM standards, as documented in the edition of the standards in force at the start of work.

1.5 INSPECTION OF WORK

Full-time, on-site inspection of all construction activities outlined in the Specifications shall be conducted by a Field Engineer provided by Gwalia. Inspection work shall include the following tasks:

a. Observation of construction activities outlined in the Specifications;

b. Testing material characteristics to ensure that materials used in the expansion conform to the requirements in the Specifications;

c. Documentation of construction activities, test locations, samples, and test results; and

d. Documentation of construction work that deviates from the Specifications.

The observation, testing, and other quality control work conducted by the Field Engineer shall be reviewed by a Professional Engineer registered in South Carolina. Documentation outlined above shall be recorded by the Field Engineer on a daily basis. This documentation shall be forwarded to the Professional Engineer on a weekly basis.

The Field Engineer shall keep the Professional Engineer updated on construction progress and test results. Deviations from these Specifications shall be discussed with and approved by the Professional Engineer.

1.6 ENVIRONMENTAL REQUIREMENTS

The Contractor shall store materials, confine equipment, and maintain construction operations according to applicable laws, ordinances, or permits for the Mine. Fuel, lubricating oils, and chemicals shall be stored and dispensed in such a manner as to prevent or contain spills and prevent said liquids from reaching local streams or ground water.

1.7 DIVERSION AND CARE OF WATER

The Contractor shall design, construct, and maintain all temporary diversion and protective works required to divert runoff around the work areas and to protect persons and property downstream of the work. The Contractor shall furnish, install, maintain, and operate all equipment required to keep excavations and other work areas free from water in order to construct the facilities as specified.

The Contractor shall suspend fill placement, foundation preparation, or liner construction operations whenever, in the opinion of the Field Engineer, conditions for such operations are unsatisfactory due to rain, snow, wind, cold temperatures, or any other reason.

2.0 SITE PREPARATION

2.1 GENERAL DESCRIPTION

This Specification Section describes the work related to clearing, soil stripping, soil stockpiling, and foundation preparation for the leach pad, collection ponds, waste disposal areas, and sediment control structures.

2.2 MATERIALS DESCRIPTION

2.2.1 Topsoil

Topsoil shall consist of the upper 8 to 12 inches of soils stripped from areas to be covered by mine facilities. These areas include the leach pad, collection pond and plant areas, waste disposal areas, and areas to be incorporated into the mine pits.

Topsoil shall primarily consist of clayey silt material, and have no rock particles greater than 6-inch size. Topsoil may have roots, stems, and other vegetative matter that was produced from clearing operations.

2.2.2 Random Fill

Random fill shall consist of minus 6-inch material excavated from the leach pad or other areas in order to reach required grades and slopes. Random fill shall not contain trash, roots, stems, or other vegetative matter.

2.3 WORK DESCRIPTION

2.3.1 Clearing

Clearing shall consist of logging (if required), grubbing, or dozing vegetation off of areas to be covered or excavated. The cleared vegetation shall be disposed of in a manner determined by the Field Engineer.

2.3.2 Stripping

Stripping shall consist of excavating the upper 8 to 12 inches of soil from areas to be covered or excavated. If these stripped soils conform to topsoil requirements (Specification Section 2.2.1), they shall be stockpiled in the topsoil stockpiles as directed by the Field Engineer.

2.3.3 Foundation Preparation

Areas to be covered by the leach pad, collection ponds, or the lowest bench of the waste disposal areas, or heavy mine structures shall be cleared of loose or soft soils (if present) and excavated to dense soils or rock, as approved by the Field Engineer.

2.3.4 Topsoil Stockpiling

Topsoil (Specification Section 2.2.1) shall be stockpiled in the topsoil stockpiles as directed by the Field Engineer. The stockpiles shall be clearly signed or marked as topsoil. The final configuration of the stockpiles shall have maximum outside slopes of 3:1 (horizontal:vertical) and seeded as directed by the Field Engineer.

2.4 PERFORMANCE STANDARDS AND TESTING

Clearing, grubbing, soil stripping, stockpiling, and foundation preparation shall be done as outlined in the Specifications and approved by the Field Engineer.

3.0 SYNTHETIC LINER

3.1 GENERAL DESCRIPTION

This Specification Section describes the work related to placement, seaming, testing, and protection of synthetic liner in the collection ponds, pond spillways, and delivery ditch.

3.2 MATERIALS DESCRIPTION

3.2.1 Upper Liner

The upper or primary synthetic liner shall consist of high density polyethylene (HDPE), or approved equivalent. The nominal liner thickness shall be 60 mil (0.060 inches). The synthetic liner shall be manufactured with products designed and manufactured for the purpose of liquid containment in hydraulic structures.

The synthetic liner shall conform the following minimum physical requirements:

Tensile strength at break	120 lbs/in width
Elongation at break	450 percent

The liner shall be resistant to liquids from pH of 7.0 to 12.0, and resistant to liquids containing cyanides and dissolved metals. The liner shall also be resistant to ultraviolet radiation in areas where the liner material is not covered with agglomerate or other materials.

The liner shall be manufactured to be free of holes, blisters, undispersed raw materials, or visible evidence of contamination by foreign matter. Any such defect shall be repaired according to the liner manufacturer's recommendations.

Labels on the liner roll or panel shall identify the thickness, length, width, and manufacturer's mark number. Transport and storage of the liner material shall be according to manufacturer's recommendations.

3.2.2 Lower Liner

The lower or secondary synthetic liner shall consist of polyvinyl chloride (PVC) or approved equivalent. The nominal liner thickness shall be 20 mil (0.020 inches). The synthetic liner shall be manufactured with products designed and manufactured for the purpose of liquid containment in hydraulic structures.

The synthetic liner shall conform the following minimum physical requirements:

Tensile strength at break	45 lbs/in width
Elongation at break	325 percent

The liner shall be resistant to liquids from pH of 7.0 to 12.0, and resistant to liquids containing cyanides and dissolved metals.

The liner shall be manufactured to be free of holes, blisters, undispersed raw materials, or visible evidence of contamination by foreign matter. Any such defect shall be repaired according to the liner manufacturer's recommendations.

Labels on the liner roll or panel shall identify the thickness, length, width, and manufacturer's mark number. Transport and storage of the liner material shall be according to manufacturer's recommendations.

3.2.3 Geodrain

A geodrain netting shall be installed between the upper and lower pond liners on the bottom of the solution collection ponds or other areas designated on the Drawings as Synthetic Liner B.

The geodrain shall consist of high density polyethylene (HDPE), or approved equivalent. The nominal geodrain thickness shall be 160 mil (0.160 inches). The geodrain shall be resistant to liquids from pH of 7.0 to 12.0, and resistant to liquids containing cyanides and dissolved metals.

3.2.4 Pea Gravel

Pea gravel shall be placed between the upper and lower synthetic liners in the solution ponds in the sump areas, as shown on Drawing 190-3. The pea gravel shall be of uniform grading, with a nominal size of 1/4 inch. The pea gravel shall be free of trash, vegetative matter, sharp objects, and any other deleterious material.

3.2.5 Filter Fabric

Filter fabric shall be installed between the upper and lower pond liners on the side slopes of the solution collection ponds or other areas designated on the Drawings as Synthetic Liner A.

The filter fabric shall be a nonwoven material with a nominal thickness of 100 mil (0.100 inches), and a fabric weight of 7 ounces per square yard. The filter fabric shall be resistant to liquids from pH of 7.0 to 12.0 and resistant to liquids containing cyanides and dissolved metals.

3.3 WORK DESCRIPTION

3.3.1 Surface Preparation

The lower synthetic liner (Specification Section 3.2.2) shall be installed on top of prepared liner bedding material, consisting of suitable fine-grained soils. The surfaces beneath the lower synthetic liner shall provide a smooth and unyielding foundation for the liner with no sharp or protruding objects or abrupt changes in grade.

The upper synthetic liner (Specification Section 3.2.1) shall be installed on top of geodrain (Specification Section 3.2.3) or filter fabric (Specification Section 3.2.5). The surfaces beneath the upper synthetic liner shall provide a relatively smooth and clean foundation for the liner with no sharp or protruding objects or abrupt changes in grade.

3.3.2 Liner Placement and Seam Welding

Installation of the synthetic liner shall be only on areas approved by the Field Engineer, as outlined in Specification Section 3.3.1.

Individual panels of synthetic liner material shall be laid out and overlapped a minimum of 4 inches prior to welding, or as recommended otherwise by the manufacturer. The overlapping panels shall be shingled, such that the upslope panel is on top of the downslope panel. The seams to be welded shall be cleaned and prepared according to manufacturer's guidelines. All liner panel seams shall be welded or bonded together to form a continuous, watertight barrier.

If HDPE synthetic liner materials are used, field welding shall be a heat extrusion process, which forms a continuous bond between the extrudate and the liner material, according to the guidelines of the manufacturer. The field welding equipment shall be capable of continuously monitoring and controlling the temperatures and pressures in zone of contact where the machine is actually fusing the lining material to prevent changes in environmental conditions from affecting the integrity of the weld.

If PVC or other similar synthetic liner materials are used, field welding shall be according to the guidelines of the manufacturer. Field welding shall be between like materials only, and field welding of different materials (such as PVC to HDPE) shall not be done.

Liner installation shall be done without puncturing, tearing, or otherwise damaging the liner. Any punctures, overlaps (fishmouths), or other unacceptable condition of the liner shall be repaired with an overlapping patch bonded to the liner by field welding.

Prior to placement of geodrain, pea gravel, or filter fabric, or prior to filling the ponds with fluids, the synthetic liner shall be protected from uplift due to wind by placing sand bags, rubber tires, or other approved equivalent on top of the liner.

3.3.3 Liner Anchoring

Around the perimeter of the leach pad, ponds, and delivery ditch, the synthetic liner shall be anchored in a trench as shown on Drawings 190-3, or according to manufacturer's guidelines. The synthetic liner shall extend a minimum of one foot into the trench. Soil will be placed in the trench and compacted to anchor the liner at its perimeter.

3.3.4 Liner Testing

Testing of the installed synthetic liner shall consist of physical examination of the liner panels and seams, and field seam testing. The Field Engineer or approved subcontractor shall test all synthetic liner seams. All flaws in the seams or liner panels resulting from the installation will be repaired prior to placement of protective materials over the liner.

3.4 PERFORMANCE STANDARDS AND TESTING

All synthetic liner panels and seams shall be tested according to Specification Section 3.3.4. Panel and seam locations, seam test results, repair locations, and seam retest results shall be documented by the Field Engineer.

4.0 LEACH PAD AND TRANSPORT CHANNEL CONSTRUCTION

4.1 GENERAL DESCRIPTION

This Specification Section describes the work related to construction of the heap leach pad and surrounding transport channel.

4.2 MATERIALS DESCRIPTION

4.2.1 Compacted Fill Material

Areas beneath the leach pad and transport channel that require fill placement to reach required grades (1 ft 5 inches below top of asphalt liner) shall be filled with soils from required excavations or mine stripping. Random fill material shall be minus six inch size and free from trash, vegetative matter, or other deleterious material.

4.2.2 Geotextile

Geotextile shall be placed on top of compacted fill in areas to be covered by asphalt liner. Geotextile shall be a woven material, such as Mirafi 600X or equivalent.

4.2.3 Road Base Material

The road base material forming the bottom of the asphalt liner shall consist of a durable, well-graded sand and gravel. The material shall meet the following grain-size distribution requirements:

Sieve Size	Percent Passing
3/4 inch	100
3/8 inch	60-80
No. 4	35-65
No. 8	20-50
No. 50	3-20
No. 200	0-8

4.2.4 Asphalt

The asphalt shall consist of a mixture of asphaltic cement (AC-20, or as approved by the Professional Engineer) and a durable mineral aggregate. The amount of asphaltic cement and the gradation of the mineral aggregate shall be determined prior to construction by mix design. The mix design will be performed under the direction of the Professional Engineer using local potential aggregate sources.

The asphalt will be batched with conventional asphalt mixing equipment capable of developing uniform and homogeneous material.

4.2.5 Paving Fabric (Petrotac)

A paving fabric shall be placed between the two lifts of asphalt. This paving fabric shall consist of Petrotac or approved equivalent material.

4.2.6 Leak Detection Pipe

Leak detection pipe shall consist of minimum 2-inch diameter slotted and blank pipe. The pipe shall be Schedule 40 PVC or approved equivalent. If slotted PVC or other rigid pipe is used, slot sizes shall be a maximum of 1/32 inch (0.8 millimeters).

4.2.7 Leak Detection Sumps

The leak detection sumps at the outlets of the leak detection pipes shall consist of polyethylene or PVC pipe, or other approved equivalent pipe or plastic tubing material. The leak detection sumps shall have a minimum inside diameter of five inches and a minimum wall thickness of 100 mil (0.100 inches). The leak detection sumps shall extend below where the leak detection pipe enters the sump a minimum of 24 inches.

The leak detection sumps shall be properly sealed at the bottom of the sump and on all material joints to prevent leakage from the sumps.

4.3 WORK DESCRIPTION

4.3.1 Compacted Fill Placement

Compacted fill material (Specification Section 4.2.1) shall be placed in horizontal lifts of 1-ft maximum thickness. Each lift shall be compacted to at least 95 percent of the Modified Proctor density (ASTM D 1557) for the material.

During compaction, the material shall be within 2 percent above to 2 percent below optimum moisture content for the material. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the random fill material prior to placement. The fill shall be compacted with a tamping-foot roller or vibratory steel-drum roller, as approved by the Field Engineer.

The compacted fill shall be keyed into the site foundation such that no loose, soft, or other deleterious materials remain between placed compacted fill and leach pad foundation.

In areas where natural soils are to be covered by leach pad and no compacted fill is required, the upper one ft of natural material shall be scarified, moisture conditioned, and compacted as outlined in this Specifications Section.

4.3.2 Geotextile Placement

The geotextile (Specification Section 4.2.2) shall be placed on top of the compacted fill (Specification Section 4.3.1), and extend 20 ft beyond the outside edges of compacted fill. The geotextile shall be installed and seamed according to manufacturer's specifications.

4.3.3 Road Base Placement

Road base material (Specification Section 4.2.3) shall be placed on top of the geotextile (Specification Section 4.3.2) in areas beneath the leach pad and transport channel. The road base material shall be placed in two horizontal lifts of 6-inch maximum thickness. Each lift shall be compacted to at least 95 percent of the Modified Proctor density (ASTM D 1557) for the material.

During compaction, the material shall be within 2 percent above to 2 percent below optimum moisture content for the material. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the random fill material prior to placement.

The fill shall be compacted with a vibratory steel-drum roller or equivalent, as approved by the Field Engineer.

4.3.4 Asphalt Placement

The asphalt material shall be placed in two 2.5-inch lifts and compacted. The material shall be placed with convention asphalt paving equipment. Minimum placement temperatures will be determined by the Field Engineer during the mix design (Specification Section 4.2.4), and the mix design minimum temperature requirements shall be followed.

The asphalt shall be compacted with a steel drum or pneumatic-tired compactor, and shall be compacted to the minimum densities as determined from the mix design.

4.3.5 Paving Fabric Placement

After the bottom lift of asphalt has been placed, the paving fabric (Specification Section 4.2.5) shall be installed. The paving fabric shall be installed in accordance with the manufacturer's recommendations which may require use of an emulsified asphalt tack coat. The paving fabric surface shall be free from wrinkles and bulges prior to the placement of the upper lift of asphalt.

4.3.6 Asphalt Berm Construction

Asphalt berms shall be constructed of asphalt (Specification Section 4.2.3), at locations on the leach pad (shown on Drawing 190-2) on top of the asphalt liner. The berm shall be constructed with standard asphalt curb equipment and shall have the minimum dimensions as shown on Drawing 190-2.

4.3.7 Leak Detection System

The leak detection system shall be installed along the bottom edge of each leach pad terrace, as shown on Drawings 190-2 and 190-3. The leak detection system shall consist of slotted PVC pipe (Specification Section 4.2.6) placed in the bottom of the road base material beneath the transport channel. Blank PVC pipe shall be connected to the slotted PVC pipe and sloped towards the leak detection sump (Specification Section 4.2.7).

4.4 PERFORMANCE STANDARDS AND TESTING

4.4.1 Grading Standards

The top surface of each leach pad component (compacted fill, road base and asphalt) of the leach pad foundation shall be graded to achieve required grades and elevations. The top surface shall be smooth and free of depressions or humps that would hinder drainage on the leach pad.

4.4.2 Compacted Fill and Road Base

Compaction of the random fill and road base shall be tested at a minimum frequency of one test per 1000 cubic yards of material placed. More tests may be required during initial material placement or if there are variations in the material. Test locations, test results, and retest results shall be documented by the Field Engineer.

4.4.3 Asphalt Standards and Testing

The asphalt shall be tested for compaction and composition at a rate of one test every 100 cubic yards of material placed. Testing shall consist of asphaltic cement content, gradation of aggregate, Marshall series (stability, flow and density) and in-place density. The asphalt shall meet the requirements determined from the mix design.

5.0 SOLUTION POND CONSTRUCTION

5.1 GENERAL DESCRIPTION

This Specification Section describes the work related to construction of the pregnant, barren, wash water, and carbon ponds.

5.2 MATERIALS DESCRIPTION

5.2.1 Compacted Fill

Areas beneath the pond surfaces that require fill placement to reach required grades shall be filled with soils from required excavations or mine stripping. Random fill material shall be minus six inch size and free from trash, vegetative matter, or other deleterious material.

5.2.2 Liner Bedding Layer Material

The liner bedding material shall consist of minus 1.5-inch material. The liner bedding material shall be obtained from the near surface soils excavated in the pond, leach pad area, or pit areas. The bedding layer material shall be free of sharp objects, rubbish, vegetative matter and any deleterious material.

5.2.3 Interliner Material

Drainage material between pond synthetic liners shall be geodrain (Specification Section 3.2.3), or filter fabric (Specification Section 3.2.5) with pea gravel (Specification Section 3.2.4) in the interliner sumps.

5.2.4 Leak Detection Pipe

Leak detection pipe shall consist of minimum 4-inch diameter slotted and blank pipe. The pipe shall be Schedule 40 PVC or approved equivalent. If slotted PVC or other rigid pipe is used, slot sizes shall be a maximum of 1/32 inch (0.8 millimeters).

5.3 WORK DESCRIPTION

5.3.1 Compacted Fill Placement

Compacted fill material (Specification Section 5.2.1) shall be placed in horizontal lifts of 1.5-ft maximum thickness. Each lift shall be compacted to at least 90 percent of the Modified Proctor density (ASTM D 1557) for the material. The fill shall be compacted with a tamping-foot roller or vibratory steel-drum roller, as approved by the Field Engineer.

The compacted fill shall be keyed into the site foundation such that no loose, soft, or other deleterious materials remain between placed compacted fill and pond area foundation.

In areas where natural soils are to be covered by ponds and no compacted fill is required, the upper one ft of natural material shall be scarified, moisture conditioned, and compacted as outlined in this Specifications Section.

5.3.2 Liner Bedding Layer Placement

The liner bedding layer shall be constructed of liner bedding layer material (Specification Section 5.2.2). The liner bedding layer shall be placed on the completed and approved top surface of the pond foundation in one 6-inch lift, and compacted to form a smooth surface.

Liner bedding layer material shall be compacted to at least 90 percent of the Modified Proctor density (ASTM D 1557) for the material. The material shall be compacted with a vibratory steel-drum roller, or alternative equipment approved by the Field Engineer.

5.3.3 Interliner Layer Placement

The geodrain and filter fabric interlayer materials shall be placed according to manufacturer's guidelines (Specifications Section 3.3.2). The pea gravel shall be placed in one lift and smoothed and tamped by hand.

The interliner materials shall be placed such that the lower synthetic liner is not punctured or otherwise damaged.

5.3.4 Synthetic Liner Placement

Pond synthetic liner material shall consist of materials outlined in Specification Sections 3.2.3 and 3.2.4. Liner materials shall be installed as outlined in Specification Section 3.3.2. The pond spillway liners shall be constructed in the same manner as the ponds.

In areas where fluids enter the pregnant solution pond and in areas where suction lines rest against the liner, the upper liner shall be doubled (as shown on Drawing 190-2).

5.3.5 Synthetic Liner Protection

Prior to placement of geodrain, drain sand, or filling the ponds with fluids, the synthetic liner shall be protected from uplift due to wind by placing sand bags, rubber tires, or other approved materials on top of the liner.

5.3.6 Leak Detection System

The leak detection system shall be installed between synthetic liners on the side of each pond, as shown on Drawing 190-3.

5.4 PERFORMANCE STANDARDS AND TESTING

The ponds shall be constructed to grades and elevations shown on Drawing 190-2, and shall have bottom slopes that drain to the sumps. The sumps shall be connected to the leak detection system as shown on Drawing 190-3.

6.0 DELIVERY CHANNEL

6.1 GENERAL DESCRIPTION

The Specification Section describes the work related to the construction of the delivery channel, which will convey the process fluids from the transport channel to the pregnant solution pond.

6.2 MATERIALS DESCRIPTION

6.2.1 Asphalt

The asphalt used for the upper portion of the delivery channel shall be as specified in Specification Section 4.2.4.

6.2.2 Paving Fabric

The paving fabric, which shall be placed between the two lifts of asphalt in the delivery channel, shall be as specified in Specification Section 4.2.5.

6.2.3 Concrete

The concrete used in the transition between the asphalt and synthetically lined sections of the delivery channel shall contain materials that conform to Part 2 of American Concrete Institute (ACI) guideline 318-83.

Cement used for concrete shall be portland cement meeting the requirements of ASTM C150. Coarse aggregate shall be crushed rock, washed gravel, or other inert granular material conforming to ASTM C33. Fine aggregate shall be clean sand that conforms to ASTM C33. Fresh water shall be used to make up the concrete, as outlined in Part 2 of ACI 318-83.

Cast-in-place concrete shall have the following properties:

28-day Compressive Strength	3000 psi
Maximum Slump	6 inches
Air Content	3-5 percent
Maximum water-cement ratio	0.50

The concrete shall be batched, mixed, transported, placed, and cured in accordance with applicable standards in Part 3 of ACI 318-83.

6.2.4 Concrete Reinforcement

Concrete reinforcement shall consist of steel reinforcing bars (rebar). Rebar shall be No. 4 size and Grade 60, conforming to ASTM A615(S1). Splices in rebar shall be a Class A splice, as outlined in Part 3 of ACI 318-83.

6.2.5 HDPE-Concrete Anchor Sheet

A HDPE-concrete anchor sheet shall be embedded in concrete to provide a connection between the concrete and the HDPE liner. The anchor sheet shall have a minimum thickness of 100 mil (0.100 inches) and shall be specifically manufactured for the purpose of providing a connection between HDPE and concrete

6.2.6 Channel Synthetic Liner

The lower portion of the delivery channel shall be lined with the same synthetic materials used for the sides of the ponds (Synthetic Liner A, as shown on Drawing 190-3). Liner materials shall meet the requirements outlined in Specification Sections 3.2.1, 3.2.2, and 3.2.5.

6.3 WORK DESCRIPTION

6.3.1 Asphalt Placement

The asphalt shall be placed as described in Specification Section 4.3.4. Care shall be taken to ensure that a good contact is achieved between the asphalt and the concrete transition, especially in the areas where the asphalt is keyed into the concrete (Drawing 190-3).

6.3.2 Concrete Placement

The cast-in-place concrete transition shall be constructed to the dimensions shown on Drawing 190-3. The concrete surfaces that will be in contact with asphalt shall be finished with a rough broom finish. The surface of the concrete that will be exposed in the channel shall be finished to a smooth surface.

All reinforcement shall be free of rust, oil, dirt and other foreign material at the time of concrete placement.

6.3.3 HDPE-Concrete Anchor Sheet Placement

The anchor sheet shall be installed in accordance with manufacturer's specifications. Care shall be taken to ensure a good bond between the concrete and the protrusions from the bottom of the anchor sheet.

6.3.4 Lower Liner Placement

The lower liner of the delivery channel (Specification Section 3.2.2) shall be placed as described in Specification Section 3.3.2. The liner foundation shall be prepared as described in Specification Section 3.3.1. The lower liner shall be anchored in the transition area as shown on Drawing 190-3.

6.3.5 Filter Fabric Placement

The filter fabric (Specification Section 3.2.5) that shall be placed between the upper and lower liners shall be installed as described in Specification Section 3.3.2.

6.3.6 Upper Liner Placement

The upper liner (Specification Section 3.2.1) shall be placed and anchored as specified in Specification Sections 3.3.2 and 3.3.3. The liner shall be welded to the HDPE-concrete anchor sheet. An HDPE cap shall then be welded over the original weld, as shown on Drawing 190-3. All welding shall be performed as described in Specification Section 3.3.3.

6.4 PERFORMANCE STANDARDS AND TESTING

6.4.1 Grades and Elevations

All grades and elevations shall be as shown on the Drawings. The transition between the asphalt and synthetically lined sections of the channel shall be smooth with a 1/2 inch drop from the asphalt to the concrete section.

6.4.2 Asphalt Testing

The asphalt testing shall be conducted as described in Specification Section 4.2.3.

6.4.3 Synthetic Liner Testing

The testing of the synthetic liner welds and seams shall be conducted as described in Specification Section 3.3.2.

6.4.4 Concrete Testing

One series of tests shall be conducted on the concrete material. The testing shall include a slump test, and an entrained air test on the fresh concrete. In addition, at least four cylinders shall be cast and tested for compressive strength. At least two of the four cylinders shall be tested at 28 days. All testing shall conform with ACI standards for testing and curing concrete samples.

7.0 HEAP CONSTRUCTION

7.1 GENERAL DESCRIPTION

This Specification Section describes the work related to agglomerated ore placement and general construction of the heaps.

7.2 MATERIALS DESCRIPTION

7.2.1 Agglomerate

Agglomerate shall consist of minus 1/2-inch crushed and agglomerated ore.

7.2.2 Drain Pipes

Slotted pipes shall be used to aid in the drainage of the heaps during the leaching process. The drain pipes shall consist of minimum 4 inch diameter ADS drainage pipes or approved equivalent.

7.3 WORK DESCRIPTION

7.3.1 Agglomerate Placement

Agglomerate shall be placed by way of a radial stacker to construct heaps in a loose and uniform manner to optimize solution contact. Agglomerate shall be placed only on segments of the leach pad where drain pipes have been installed.

7.3.2 Drainage Pipe Placement

The drainage pipes shall be placed on top of the asphalt pad prior to the placement of the ore. The pipes shall be placed parallel to the leach pad fall line and shall have a minimum spacing of 20 ft.

7.4 PERFORMANCE STANDARDS AND TESTING

No performance standards or testing are required.

8.0 WASTE DISPOSAL AREAS

8.1 GENERAL DESCRIPTION

This Specification Section describes the work related to the construction of the three waste disposal areas.

8.2 MATERIAL DESCRIPTION

8.2.1 Waste Rock

Waste rock is any material that is taken from the mine pit that is not processed as ore. It is expected that this material will be of variable particle size distribution, ranging from coarse rock (maximum size approximately 5 ft) to rock with very little fines content. This material shall be placed in the waste disposal areas.

8.2.2 Coarse Waste Rock

This material shall consist of select waste rock (Specification Section 8.2.1) which shall be used to construct selected areas of the toe of the waste rock disposal areas. Coarse waste rock shall be durable and have no more than 5 percent passing the No. 200 sieve, or approved otherwise by the Field Engineer.

8.2.3 Leached Agglomerate

Leached agglomerate shall be placed in the waste disposal areas. This material shall consist of the leached, agglomerated ore that has been rinsed to acceptable cyanide concentrations.

8.3 WORK DESCRIPTION

8.3.1 Foundation Preparation

Waste disposal area foundation preparation shall consist of removal of the upper one-ft of topsoil material from beneath the waste disposal area. Any soft or loose areas that exist after the topsoil has been removed shall be removed, as directed by the Field Engineer.

8.3.2 Drain and Lower Bench Construction

The drain and lower bench areas as shown on Drawings 190-4 and 190-5 shall be constructed of coarse waste rock (Specification Section 8.2.2). This material shall be placed by end dumping and dozing to the grades and elevations shown on the Drawings.

8.3.3 Retention Berm Construction

A retention berm shall be constructed on the downstream end of the lower bench of each waste disposal area, as shown on Drawings 190-4 and 190-5. The retention berm shall be constructed of minus 18-inch waste rock (Specification Section 8.2.1) placed in 24-inch lifts. The retention berms shall be shaped as shown on Drawings 190-4 and 190-5.

8.3.4 Waste Rock and Leached Agglomerate Disposal

The waste rock and leached agglomerate shall be placed in the disposal area to the grades and elevations shown on Drawings 190-4 and 190-5. The benches shall have a minimum width of 50 ft, and the maximum overall slope of the areas between the benches shall be 3:1 (horizontal:vertical).

The waste rock and leached agglomerate may be co-disposed without keeping the materials separate. The materials shall be placed by end dumping and dozing.

8.4 PERFORMANCE STANDARDS AND TESTING

No performance standards or testing are required.